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Jeffrey S. Allmon
Melissa M. Krueger
Pinnacle West Capital Corporation
400 North 5th Street, MS 8695
Phoenix, Arizona 85004
Tel: (602) 250-2439
Fax: (602) 250-3393
E-Mail: Jeffrey.Allmon@pinnaclewest.com
Melissa.Krueger@pinnaclewest.com

Attorneys for Arizona Public Service Company

BEFORE THE ARIZONA CORPORATION COMMISSION

COMMISSIONERS

LEA MÁRQUEZ PETERSON, Chairwoman
SANDRA D. KENNEDY
JUSTIN OLSON
JIM O'CONNOR
ANNA TOVAR

IN THE MATTER OF THE APPLICATION FOR APPROVAL OF ARIZONA PUBLIC SERVICE COMPANY'S DISTRIBUTED GENERATION INTERCONNECTION MANUAL.	DOCKET NO. E-01345A-20-0152 **ARIZONA PUBLIC SERVICE COMPANY'S REVISED INTERCONNECTION MANUAL SUBMITTAL**

Pursuant to A.A.C. R14-2-2628(A), APS files its revised and updated Interconnection Requirements for Distributed Generation (Revised Interconnection Manual) for Commission review and approval (*see* Attachment A). On July 24, 2020, APS filed its prior version of the Company's Interconnection Requirements for Distributed Generation and it is currently pending Commission approval. As a result of discussions between APS and stakeholders, APS developed modifications to the Interconnection Requirements for Distributed Generation while the previous version filed in July of 2020 has been pending approval. Because APS believes that the Revised Interconnection Manual filed herein is more responsive to and better addresses customer interconnection needs, while still complying with good utility practice and ensuring the safe

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interconnection of customer generating facilities to the APS distribution system, APS submits the Revised Interconnection Manual for Commission approval.

In addition, as part of APS's initial July 2020 filing of the prior Interconnection Requirements for Distributed Generation, APS requested a waiver of A.A.C R14-2-2615(F), also known as Screen F. APS hereby renews its request for a waiver of Screen F for the Revised Interconnection Manual, based on the rationale articulated in the Company's July 2020 filing. As stated in that earlier filing, good cause exists for the Commission to waive APS's compliance with A.A.C R14-2-2615(F).

Based on the foregoing, APS respectfully requests that the Commission approve its Revised Interconnection Manual and grant APS's request for waiver of A.A.C. R14-2-2615(F). To assist with the Commission's evaluation of this request, the Revised Interconnection Manual that is attached herein contains two versions, one clean (Attachment A) and one redlined (Attachment B), which shows changes made since APS's initial July 2020 filing of the Interconnection Requirements for Distributed Generation. The attached Revised Interconnection Manual hereby supersedes and replaces that earlier filing.

RESPECTFULLY SUBMITTED this 6th day of May 2022.

By: /s/ Jeffrey S. Allmon
Jeffrey S. Allmon
Melissa M. Krueger
Attorneys for Arizona Public Service Company

ORIGINAL electronically filed
this 6th day of May 2022, with:

Docket Control
ARIZONA CORPORATION COMMISSION
1200 West Washington Street
Phoenix, Arizona 85007

COPY of the foregoing e-mailed/delivered this 6th day of May 2022 to:

Robin Mitchell
Director & Chief Counsel – Legal Division
Arizona Corporation Commission
1200 West Washington Street
Phoenix, Arizona 85007

Sarah N. Harpring
Assistant Chief Administrative Law Judge
Arizona Corporation Commission
1200 West Washington Street
Phoenix, Arizona 85007

Elijah O. Abinah
Director, Utilities Division
Arizona Corporation Commission
1200 West Washington Street
Phoenix, Arizona 85007

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ATTACHMENT A

INTERCONNECTION MANUAL

CLEAN

Interconnection Requirements

For

Distributed Generation

Arizona Public Service Company

Submitted to Arizona Corporation Commission May 06, 2022
Rev. 9.0

APS Interconnection Requirements for Distributed Generation
Statement of Ownership

This Interconnection Requirements manual is owned and maintained by the APS Distributed Resources Engineering team. Originally published by APS in June 1985, this document continues to be updated to address evolving industry standards, industry recommended practices, safety concerns, technology advancements, and regulatory requirements. This document is updated and approved via committee with input from various internal and external groups. Internal input is obtained from APS departments such as System Protection, SCADA, Operations, Meter Shop, Legal, Regulatory, Program, Technical Projects, Safety, and Interconnection. External input is obtained from various industry experts and interested parties, including Generating Facility designers and installers, consulting engineers, electric utilities, and equipment manufacturer representatives. Any questions or suggestions regarding this document should be directed to the APS Distributed Resources Engineering team.

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1 INTRODUCTION

This document specifies the minimum requirements for safe and effective operation of any Distributed Generation electrically interconnected (or paralleled) with the Arizona Public Service Company (APS or Company) distribution system (21 kV or less). APS Customers and/or Customer's authorized representatives and APS personnel shall use this document when planning for the installation of any Backup Generator or Generating Facility (GF). Application for interconnection is made by completing and submitting to APS the applicable Interconnection Application. The APS Interconnection Application Process Guide is available at www.aps.com/dg.

Interconnections on the distribution system that do not sell power for resale will follow the process outlined by the Arizona Corporation Commission (ACC) with the following tracks:

- R14-2-2617 Level 1 Super Fast Track – A customer interconnecting an inverter-based Generating Facility with a Maximum Capacity of 20 kW or less, which only uses Certified Equipment.
- R12-2-2618 Level 2 Fast Track – A customer interconnecting a Generating Facility with a Maximum Capacity of less than 2 MW, excluding a Generating Facility processed in accordance with R14-2-2617.
- R14-2-2619 Level 3 Study Track – A customer interconnecting a Generating Facility with a Maximum Capacity of 2 MW or greater, or a Generating Facility that does now meet the screening requirements for Level 1 Super Fast Track, Level 2 Fast Track, or transfer from Supplemental Review.
- R14-2-2620 Supplemental Review – If a Utility determines that an Application for Interconnection cannot be approved without conducting a Supplemental Review, or if requested by the Applicant.
- R14-2-2623 Expedited Interconnection Process – A customer interconnecting a Non-Exporting inverter-based energy storage Generating Facility or an Inadvertent Export Generating Facility with a Maximum Capacity of 20 kW or less may apply for interconnection under the Expedited Interconnection Process. In order to qualify for the Expedited Interconnection Process, the customer's Generating Facility must meet the applicable conditions specified in subsection (B) and (C) of R14-2-2623.

Detailed information can be found at the following website:

https://apps.azsos.gov/public_services/title_14/14-02.pdf.

Installations that are directly connected to the transmission system or sell power for resale, except in limited circumstances described later, have additional APS requirements. In such cases an interconnection application may need to be made in accordance with APS's Open Access Transmission Tariff (OATT). Further information can be obtained by accessing the following website: www.oatioasis.com/azps/index.html and clicking on the link entitled Applications.

If a generator interconnects to the APS transmission system (higher than 21 kV), and is not subject to APS's OATT, such interconnection may be performed in accordance with this document. APS will work with Customer and advise of additional requirements.

These requirements may not cover all details in specific cases. This document must be applied in conjunction with the following APS documents that pertain to the parallel operation of Customer-owned Distributed Generation with the APS System:

- Schedule #1, Terms and Conditions for Standard Offer and Direct Access.
- Schedule #2, Terms and Conditions for Energy Purchases from Qualified Cogenerators and Small Power Production Facilities.
- Schedule #4, Totalized Metering of Multiple Service Entrance Sections at A Single Site for Standard Offer and Direct Access Service.
- Schedule #5, Guidelines for Electric Curtailment.
- Schedule #6, Interconnection Services and Fees for Non-FERC Generation Facilities.
- APS Electric Service Requirements Manual (ESRM).

The Service Schedules listed are available via www.aps.com.

The ESRM is available at: www.aps.com/ESRM.

The minimum required protective relaying and/or safety devices and requirements specified in this document are for protecting only APS facilities and the equipment of other Customers from damage or disruptions caused by a fault, overcurrent condition, malfunction, or improper operation of the GF. These requirements are also necessary to ensure the safety of utility workers and the public. Minimum protective relaying and interconnection requirements do not include additional relaying, protective or safety devices as may be required by industry and/or government codes and standards, equipment manufacturer requirements and prudent engineering design and practice to fully protect the Customer's GF. Those additional relaying, protective or safety devices are the sole responsibility of such Customer.

In addition to all applicable regulatory, technical, safety, and electrical requirements and codes, which are not contained in their entirety in this document, Customers are also subject to contractual and other legal requirements, which may only be summarized or referenced in this document. Those regulations, requirements, contracts and other materials contain complete information concerning interconnection and govern over the general provisions in this document.

The technical interconnection requirements outlined in this document also apply to any interconnected utility-owned or operated GF.

This document, as well as the various Agreements and rate schedules, is subject to revision and Commission oversight. Check with APS, or go to www.aps.com/dg, for the latest revision prior to commencing your project.

APS is committed to ensuring that Interconnection Applications are handled promptly, and to do everything possible to complete the interconnection process in a safe and timely manner. At APS, we look forward to working with you to ensure a successful generation project.

2 DEFINITIONS

The following capitalized terms, as used in this document, shall have the meanings specified:

Advanced Inverter: A grid interactive Static Inverter with functions to allow for more elaborate monitoring and communication of the grid status, the ability to receive operation instructions from a centralized location, and the capability to make autonomous decisions to improve grid stability, support power quality, and provide ancillary services such as voltage regulation, power factor control and reactive power control.

Advanced Metering Infrastructure (AMI): The APS-owned Metering system whereby electrical meters transmit electric usage and other data via a radio and/or cell phone communication system to a central data collection system.

Agreement: See "Interconnection Agreement."

ANSI: American National Standards Institute. See www.ansi.org.

Application (also referred to as the **Interconnection Application):** The standard form as specified/referenced in the APS Interconnection Application Process Guide available at www.aps.com/dg.

APS: Arizona Public Service Company.

APS Interconnection Requirements: The requirements set forth in this document entitled "Interconnection Requirements for Distributed Generation Arizona Public Service Company" and all additional requirements that are referenced in this document.

APS System (also referred to as the **Utility System):** Refers to APS's Electrical Transmission or Distribution System.

Arizona Administrative Code (A.A.C.) Article 26, Interconnection of Distributed Generation Facilities (ACC Interconnection Rules): Polices, processes and timeframes which governs how APS and the Customer will interconnect a GF operated in continuous parallel with the APS System.

Arizona Corporation Commission (ACC or **Commission):** The regulatory agency of the State of Arizona having jurisdiction over public service corporations, including APS, operating in Arizona. See www.azcc.gov

Authority Having Jurisdiction (AHJ): The organization, office, or individual responsible for enforcing the requirements of a code or standard or for approving equipment, materials, an installation, or a procedure.

Backfeed: To energize any section of the APS System from an electric source other than the normal utility source.

Backup Generator: An independent power generation source or sources located at a Customer's facility installed for the sole purpose of supplying on-site generated power to Essential Loads upon failure or outage of the normal utility source. A Backup Generator shall be understood to include Critical, Emergency and Standby Power Systems as defined in IEEE Std. 446 and the NEC.

Behind the Meter (BTM): A term used to describe a power generation application in which the GF generation is not directly interconnected to the APS System but rather, to a Customer-owned electric

system that is itself electrically connected to APS System via an APS retail billing meter. A BTM application is commonly referred to as a R-DER.

Bi-Directional Meter: A meter having two separate metering registers, one to record electricity delivered to Customer and the other to record electricity received from Customer.

Business Day: Monday through Friday, excluding Federal and Arizona State holidays.

Clearance: A statement by one having complete authority over all parts of a circuit or piece of electrical equipment that said circuit or equipment is disconnected from all known sources or power. It is assurance that all proper precautionary measures have been taken and workers may proceed with grounding the circuit.

Clearance Point: The physical location on a section of a power line or equipment that is to be visibly disconnected from all known power sources of power.

Closed Transition Transfer (CTT): The transfer of electrical load between two power sources (normally the Utility grid and Customer's Generator) in which the power sources electrically synchronize and parallel for a period of time to transfer load between the power sources without interrupting power to the load. This is also referred to as a "make-before-break" Transfer Switch or Scheme. A CTT may be accomplished by either a Momentary Parallel Transition or a Smooth Parallel Transition.

Cogeneration Facility: Any facility that sequentially produces electricity, steam or forms of useful energy (e.g., heat) from the same fuel source and which are used for industrial, commercial, heating, or cooling purposes.

Continuous Parallel: A GF that electrically parallels with the APS System for more than 15 seconds.

Customer: An APS account holder or APS "Customer of Record" that receives electric service from APS and which may also generate electricity at the property receiving electric service. A Customer shall be understood to include any independent party or entity that either invests in, owns or operates the GF including without limitation its grantees, lessees or licensees.

Dedicated Utility Feeder: A Distribution System feeder placed into service with the sole purpose of serving a single Customer. A non-Dedicated Utility Feeder (sometimes referred to as a Shared Feeder) serves multiple Customers. A Dedicated Utility Feeder may be required to serve a U-DER meeting criteria outlined in Section 11.5(G).

Utility Disconnect (Disconnect): A visible open disconnect device that Customer is required to install and maintain in accordance with the requirements set forth in this document. It will completely isolate Customer's GF from the APS System, including the utility metering equipment located at the SES.

Distributed Energy Resource (DER): A source of electric power that is connected to the APS System, either Behind the Meter in the Customer's premise, or on the Utility's primary distribution system. A DER shall include either/or Generators and Energy Storage technologies capable of exporting active power to the APS System.

Distributed Generation (DG): Any type of electrical Generator, Static Inverter or GF interconnected with the APS System that either (a) has the capability of being operated in electrical parallel with APS's System, or (b) can feed a Customer load that can also be fed by the APS System. A DG facility is also referred to as a Generating Facility or GF in this document.

Distribution System: The infrastructure constructed, maintained, and operated by APS to deliver electric service at the distribution level (21 kV or less) to retail Customers. This is also referred to as the APS System or APS's System.

Electric Service: Service provided by APS to Customer in accordance with all applicable APS requirements, including but not necessarily limited to APS Service Schedule 1 (Terms and Conditions for Standard Offer and Direct Access Services) and the APS ESRM, whereby electricity may be delivered by APS to Customer, or electricity may be received by APS from Customer.

The APS Service Schedules are available at www.aps.com.

EMS Meter (Energy Management System Meter): A Bi-Directional Meter installed at the GF SES that measures and records instantaneous Watts, kVA, kvars, Volts, Power Factor, Amps, and cumulative kWh (generally at 5-minute incremental data for reporting), which has the capability to transmit such data via a Remote Terminal Unit back to APS for planning, forecasting and billing purposes.

Energy Storage (ES): The capture of energy produced at one time for use at a later time. A device that stores energy with the potential to Backfeed.

ESRM: APS Electric Service Requirements Manual. See www.aps.com/ESRM.

Electric Supply/Purchase Agreement: An agreement, together with appendices, signed between APS and Customer covering the terms and conditions under which electrical power is supplied to and/or purchased from APS.

Essential Loads: Electrical loads as determined by Customer requiring 24-7 reliable continuous AC power.

Exporting System: Any type of Generating Facility that is designed to regularly Backfeed the Distribution System.

Facilities Study (FaS): A full comprehensive analysis of the actual construction requirements for the APS power delivery system, based on the information from the Feasibility Study and System Impact Study or equivalent information provided by the Customer or Customer's representative or third party. The FaS will provide the detailed costs of construction and milestones associated with the requirements. Construction may include new circuit breakers, relocation of reclosers, new utility grid extensions, reconductoring of lines, new transformers, protection requirements and interaction.

Fault Current: The level of current that can flow if a short circuit is applied to a voltage source.

Feasibility Study (FeS): A preliminary review study will assess the expected capacity requirements of the proposed generator on the delivery system compared with the available system capacity at the point of interconnection, identify any potential overload issues for the delivery system, review of short circuit currents (including contribution from the generator), as well as coordination of distribution circuit protection devices. Additionally, this study will provide an initial assessment of the complexity and likely costs for the interconnection.

FERC: Federal Energy Regulatory Commission.

Generating Facility (GF): All or part of Customer's electrical Generator(s) and/or Energy Storage together with all protective, safety, and associated equipment and improvements associated with the interconnection to, or operation in conjunction with, the APS System.

Generator: A Rotating Machine or Static Inverter used to produce electrical power.

GF: See Generating Facility.

Good Utility Practice: Any of the practices, methods, and acts engaged in or approved by a significant portion of the electric industry during the relevant time period, or any of the practices, methods, and acts which, in the exercise of reasonable judgment in light of the facts known at the time the decision was made, could have been expected to accomplish the desired result at a reasonable cost consistent with good business practices, reliability, safety, and expedition. Good Utility Practice is not intended to be limited to the optimum practice, method, or act to the exclusion of all others, but rather to be acceptable practices, methods, or acts generally accepted in the region.

IEEE: The Institute of Electrical and Electronic Engineers. See www.ieee.org/index.html.

Inadvertent Export: The unplanned, uncompensated transfer of electrical energy from a Generating Facility to the Distribution System across the Point of Interconnection.

Interconnection: The physical connection of Customer's GF with the APS System.

Interconnection Agreement (also referred to as an **Agreement**)**:** An agreement, together with appendices, signed between APS and Customer, covering the terms and conditions governing the Interconnection and parallel operation of the GF with APS.

Interconnection Application (refer to **Application**)**:** An application form and all supplementary information specified in Appendix A and the "APS Interconnection Process Guide" available at www.aps.com/dg.

Interconnection Application Screens (also referred to as **Screens**)**:** A series of technical evaluations performed by APS upon the receipt of an Interconnection Application in order to determine a proposed GFs impact on the APS System. Refer to Section 16.8 and Appendix B for additional information regarding Screens. Screens noted in Appendix B are consistent with ACC Interconnection Rules, A.A.C. R14-2-2615.

Interconnection Generation Design Review Agreement (also referred to as an **Interconnection Study Agreement**)**:** An agreement signed between APS and Customer covering the terms for APS to proceed with a detailed study (i.e., Interconnection Study) of the impact of Customer's DG on the APS System.

Interconnection Study (Study): A study or studies that may be undertaken by APS (or an APS designated third-party) in response to its receipt of a completed Application for Interconnection and parallel operation with the APS System. Interconnection Studies may include, but are not limited to, Interconnection Feasibility Studies, System Impact Studies, and Facilities Studies.

Island: A condition in which a portion of a utility electric power system is energized solely by one or more local electric power systems throughout the associated Point of Interconnection while that portion of the utility electric power system is electrically separated from the rest of the utility electric power system.

Main-Tie-Main (or Main-Tie-Tie-Main): A Transfer Scheme consisting of two main power source breakers and one or two tie breakers, designed such that electrical load can be transferred between two power sources.

Maximum Capacity: Refers to a) the nameplate AC capacity of a Generating Facility; or b) only the power transferred across the Point of Interconnection to the Distribution System, not including Inadvertent Export, if the Operating Characteristics of the Generating Facility limit the power transferred across the Point of Interconnection to the Distribution System.

Metering: The function related to measuring the transfer of electric power and/or energy.

Meter Disconnect: A visible open disconnect device that is lockable in accordance with OSHA Lock Out Tag Out (LOTO) requirements (i.e., OSHA 1910.147B), and located within the same workspace as the production meter. Customer is required to install and maintain this device in accordance with the requirements set forth in this document and the APS ESRM. It will completely isolate APS required Generator Metering from any power source(s).

Meter Socket Adapter (MSA): A device installed at the customer-owned Service Entrance Section (SES) between the meter socket in the Customer's SES and the APS revenue meter that will accept a wired connection directly from a Customer's Generating Facility, or GF.

Microgrid: A group of interconnected loads and distributed energy resources with clearly defined electrical boundaries that acts as a single controllable entity with respect to the grid and can connect and disconnect from the grid to enable it to operate in both grid connected or island mode.

Minimum Protective Devices, Relays, and Interconnection Requirements: The minimum required protective relaying and/or safety devices or requirements specified in this document, as may be revised from time to time, for the purpose of protecting only APS and its other customer facilities from damage or disruptions caused by a fault, malfunction, or improper operation of Customer's GF. Minimum Protective Relaying and Interconnection Requirements do not include relaying, protective or safety devices as may be required by industry and/or government codes and standards, equipment manufacturers and prudent engineering design and practice to fully protect Customer's GF or facilities; those are the sole responsibility of Customer.

Minor Modifications: Modifications such as grammatical errors as provided within the Interconnection Application and/or the provided Interconnection Diagrams as required per the APS Interconnection Application Process Guide available at www.aps.com/dg. Additionally, "like-for-like" modifications are permitted such as make/model of electrical equipment provided electrical ratings and equipment listings remain unchanged (i.e., inverter AC nameplate ratings) and technical requirements are not violated.

Momentary Cessation: A protective mode when no current is injected into the grid by the inverter during low or high voltage conditions outside of its continuous operating range. This is accomplished by blocking the power electronics' firing commands and the inverter does not produce real or reactive current.

Momentary Parallel Transition: A form of Closed Transition Transfer in which the transfer of electrical load between two power sources occurs by electrically paralleling the power sources for a brief period of time in order to affect a rapid transfer of load between the power sources. A Momentary Parallel Transition is accomplished by paralleling the power sources for a period not to exceed ten cycles.

NEC: National Electric Code. See www.nfpa.org/nec.

NEMA: National Electrical Manufacturers Association. See www.nema.org.

NERC: North American Electric Reliability Corporation. See www.nerc.com.

Network: An AC power distribution system that includes automatic protective devices intended to isolate the network from faulted feeders while maintaining uninterrupted service to the Customer. Network service typically includes multiple parallel services fed via multiple parallel feeders and may include (if served via secondary voltage class) parallel step-down transformation.

NFPA: National Fire Protection Association. See www.nfpa.org.

NFPA 70E: Standard for Electrical Safety in the Workplace.

Non-Exporting System: A system in which there is no designed, regular export of power from the Generating Facility to the Distribution System.

Non-Parallel Connection Agreement: An agreement, together with appendices, signed between APS and Customer, covering the terms and conditions governing the non-parallel connection and operation of the GF with APS.

Non-Wires Solutions (NWS): An electricity grid investment or project that uses non-traditional T&D solutions, such as distributed generation, energy storage, energy efficiency demand response, and grid software and controls, to defer or replace the need for specific equipment upgrades, such as T&D lines or transformers, by reducing load at a substation or circuit level.

NRTL: Nationally Recognized Testing Laboratory.

Operating Characteristics: The mode of operation of a Generating Facility (Exporting System, Non-Exporting System, or Inadvertent Exporting System) that controls the amount of power delivered across the Point of Interconnection to the Distribution System.

Operations Center: A Customer-owned facility in which monitoring and/or control of the GF occurs. The Operations Center can be a combination of automatic and manual controlled/monitored devices (i.e., relays, generator controllers, switches, etc.) to ensure the reliability and safe operation of the GF. The operations center is generally manned 24-7 and shall be reachable via APS.

Open Transition Transfer: The transfer of electrical load between two power sources (normally the Utility grid and Customer's Generator) in which the power sources are prevented from being electrically paralleled or interconnected with each other. Also referred to as a "break-before-make" transfer switch or scheme. An Open Transition transfer results in a momentary loss of power to the load from the two sources during the transfer (an Uninterruptible Power Source is sometimes used to prevent loss of power to the load or part of the load).

OSHA: Occupational Safety and Health Administration. See www.osha.gov.

Parallel System: A GF that can be electrically interconnected to a bus common with the Utility's electric power system and can operate in electrical parallel either on a momentary or continuous basis.

Partial Requirements Service: Electric service provided to a Customer that has on-site interconnected generation whereby the output from its electric Generator(s) first supplies its own electric load requirements with any excess generation (over and above Customers own load requirements at any point in time) then being back-fed into the APS System. APS supplies any supplemental electric load requirements of Customer (those not met by Customer's own generation).

Potential Open Point: For the purpose of this document, a Potential Open Point constitutes any circuit breaker, contactor, switch or similar device that can be opened and/or closed, and which is not equipped with either a sync check or synchronizing function.

Production Meter: An APS-owned electric meter installed at a GF and configured so as to record or allow calculated energy output of the GF. The Production Meter will be an AMI type, unless otherwise specified by APS.

Point of Interconnection (POI): The physical location where APS's service conductors are connected to a Customer's conductors, bus, and/or service equipment to allow parallel operation of Customer's GF with the APS System. Also referred to as the Point of Common Coupling (POCC).

Power Control System (PCS): A control system that resides within the GF that manages output from one or more DERs based on one or more current sensors situated at locations that may be remote from the generation devices. The PCS shall be listed to UL 1741 CRD and shall have the capability of controlling the charging and discharging of any/all connected Energy Storage.

Qualifying Facility (QF): Any Cogeneration or Small Power Production Facility that meets the criteria for size, fuel use, efficiency, and ownership as promulgated in 18 CFR, Chapter I, Part 292, and Subpart B of the FERC's Regulations.

Radial Line: A distribution line that originates from a substation and is normally not connected to another substation or another circuit sharing the common supply of electric power.

Readily Accessible: Capable of being reached quickly and conveniently on a 24-hour basis without requiring climbing over or removing obstacles, obtaining special permission, keys or security clearances.

Reclosing: The act of automatically re-energizing a utility power line in an attempt to restore power following a fault on the line.

Relay: An electric device that is designed to interpret input conditions in a prescribed manner and after specified conditions are met to respond to cause contact operation or similar abrupt change in associated electric control circuits.

Retail-Scale Distributed Energy Resources (R-DER): DER that offsets customer load. These DER include residential, commercial, and industrial Customers. Typically, the residential units are single-phase while the commercial and industrial units can be single- or three-phase facilities.

Rotating Machine (also referred to as a Rotating Generator): An induction or synchronous machine (or machines) used to generate alternating current (AC) electric power.

Separate System: The operation of a GF that has no possibility of operating in parallel with, or potentially Backfeeding onto, the APS System.

Service Entrance Section (SES): The Customer-owned main electrical panel or equipment located at its premises to which the Utility delivers electric energy via the Utility service drop or service lateral.

Site Inspection (or APS Site Inspection): Verification performed by an APS qualified representative (inspector) prior to granting permission to parallel/operate a GF if deemed necessary by APS. The inspection may include, but not limited to, verification that the GF is in compliance with the NEC as adopted by the local AHJ, meets all APS ESRM and Interconnection requirements, and other applicable local and/or national safety codes.

Small Power Production Facility: A facility that uses primarily biomass, waste or renewable resources, including wind, solar, and water to produce electric power.

Smooth Parallel Transition: A form of Closed Transition Transfer in which the transfer of electrical load between two power sources occurs by electrically synchronizing and paralleling the power sources for a period of time in order to effect a smooth loading (sometimes referred to as soft loading) or unloading of the respective power source. A Smooth Parallel Transition is normally accomplished by paralleling the power sources for a period of 5 to 10 seconds.

Source Device: An electrical device (e.g., switching cabinet, primary transition, or primary metering device) which is directly powered by an APS Distribution System circuit or feeder at distribution level voltage (21 kV or less).

Source Transfer Equipment: Equipment specifically designed and installed to transfer electrical load between two separate power sources. Such equipment may consist of either a Transfer Switch which must be tested and certified to UL 1008/1008A, or a custom engineered Transfer Scheme which is not listed to UL 1008/1008A. The load transfer may be accomplished either via an Open Transition Transfer or via a Closed Transition Transfer.

Static Inverter: An electronic device (or devices) used to convert direct current (DC) power into alternating current AC power.

System Impact Study (SIS) – A full technical review of the project's impact on the reliability of the APS power delivery system, including a load flow study, short-circuit study, circuit protection and coordination study, impact on system operation, stability study, and voltage collapse study. Additionally, this study will determine if any upgrades to APS's system are required to build and interconnect the project as designed.

Tap: The beginning connection point of Tap Conductors as defined by NEC Article 240.2.

Tap Conductors: Conductors that, other than service conductors, have overcurrent protection ahead of its point of supply that exceeds the value permitted for similar conductors that are protected as described elsewhere in NEC Article 240.4.

Third-Party Inspection: An inspection performed by a recognized, qualified organization or individual, that examines and/or evaluates the safety, integrity, workmanship, and installation of electrical equipment installed as part of a Generating Facility.

Totalized Metering: The measurement for billing purposes on the appropriate rate, through one meter, of the simultaneous demands and energy consumption of a Customer who receives electric service at more than one SES at a single site in accordance with APS Service Schedule 4.

Transfer Scheme: Source Transfer Equipment, which is specifically engineered and custom designed for the purpose of transferring electrical load from one power source to another. Transfer Schemes are generally not tested to UL 1008/1008A.

Transfer Switch: Source Transfer Equipment, which may be designed to be automatically or manually operated for the purpose of transferring electrical load from one power source to another. Transfer Switches must be certified and tested to UL 1008/1008A.

Transfer Trip Scheme: A form of remote trip in which a communication channel is used to transmit a trip signal from the relay location (e.g., utility substation) to a remote location (e.g., GF).

Transmission System: Utility-owned high-voltage lines (69 kV or higher) and associated equipment for the movement or transfer of electric energy between power plants and the Distribution System.

UL: Underwriters Laboratories Inc. See www.ul.com.

UL Listed: Equipment identified herein that is required to be tested and certified to an applicable UL Standard and which shall also be listed and labeled according to Section 110.3 of the NEC.

UL 98: UL Standard for Enclosed and Dead-Front Switches.

UL 1008: UL Standard for Transfer Switch Equipment.

UL 1008A: UL Standard for Medium Voltage Transfer Switches.

UL 1642: UL Standard for Lithium Batteries.

UL 1703: UL Standard for Flat-Plate Photovoltaic Modules and Panels.

UL 1741: UL Standard for Safety – Inverters, Converters, Controllers and Interconnection System Equipment for Use with Distributed Energy Resources.

UL 1741 SA: UL 1741 Standard Supplement SA – Grid Support Utility Interactive Equipment.

UL 1741 SB: UL 1741 Standard Supplement SB – Grid Support Utility-Interactive Inverters and Converters Based on IEEE 1547-2018 and IEEE 1547.1-2020.

UL 1973: UL Standard for Batteries for Use in Light Electric Rail (LER) Applications and Stationary Applications.

UL 9540: UL Standard for Energy Storage Systems and Equipment.

Utility: The electric power company (in this case APS) that constructs, operates, and maintains its electrical power system for the receipt and/or delivery of electric power.

Utility-Scale Distributed Energy Resources (U-DER): DER directly connected to the distribution bus or connected to the distribution bus through a dedicated, non-load serving feeder (i.e., Dedicated Utility Feeder). These resources are specifically three-phase interconnections, and can range in capacity, for example, from 0.5 to 20 MW although facility ratings can differ.

Utility System: See APS System.

Utility-Grade Relays: Relays specifically designed to protect and control electric power apparatus, tested in accordance with the following ANSI/IEEE standards:

(1) ANSI/IEEE C37.90-2005 (R2011), IEEE Standard for Relays and Relay Systems Associated with Electric Power Apparatus.

(2) ANSI/IEEE C37.90.1-2012, IEEE Standard Surge Withstand (SWC) Tests for Protective Relays and Relay Systems.

(3) ANSI/IEEE C37.90.2-2004 (R2010), IEEE Standard Withstand Capability of Relay Systems to Radiated Electromagnetic Interference from Transceivers.

WECC: Western Electricity Coordinating Council. See www.wecc.org.

Wholesale Generation: A GF connected directly to the APS System that sells energy and capacity directly to a Utility under a power purchase contract.

3 APS POLICY ON CUSTOMER-OWNED GENERATION

Any Customer qualifying as a QF under the Public Utility Regulatory Policies Act (PURPA) of 1978 may operate its GF in parallel with the APS System provided Customer GF will:

1. not present any hazards to APS personnel, other Customers or the public,
2. minimize the possibility of damage to APS and other Customer equipment,
3. not adversely affect the quality of service to other Customers, and
4. not hamper efforts to restore a feeder to service (specifically when a Clearance is required).

   NOTE: Customer will pay all costs to interconnect their respective GF to the APS System. Costs shall include any/all system upgrades and costs of furnishing and constructing any/all interconnection facilities.

Customer must also comply with all of the following prior to paralleling a GF with APS:

1. The GF must meet all the interconnection, safety, and protection requirements outlined in this document or as otherwise agreed upon between the Customer and APS.
2. Customer must sign an Interconnection Agreement, as well as an Electric Supply/Purchase Agreement, as applicable, with APS.
3. Customer must comply with and is subject to all applicable service and rate schedules and requirements, ACC Interconnection Rules, fees, rate tariffs and other applicable requirements as filed with and approved by the Arizona Corporation Commission, and as otherwise referenced in this document.
4. At APS's option, the GF may be inspected by APS personnel.
5. Written permission to parallel/operate must be obtained from APS.

   NOTE: When APS issues a permission to parallel/operate letter to Customer, the letter does not relieve Customer of the responsibility of full compliance with the APS Interconnection Requirements and all applicable building and safety codes, and local permitting requirements.

It is APS policy to permit Customer generating equipment with an aggregate generation AC output nominal nameplate rating of less than 1 MW that is not qualified as a QF under PURPA to operate in parallel with the APS System, provided all the conditions outlined above are complied with and Customer does not fall under FERC jurisdiction.

As required by FERC, APS must requires any GF (other than a Backup Generator), that is not owned by APS, interconnecting with the APS System, with an aggregate generation AC output nominal nameplate rating of greater than 1 MW to provide documentation acceptable to APS (including FERC Form 556), that confirms the GF has achieved QF status under 18 CFR, Chapter 1, Part 292, Subpart B, including, without limitation, §292.207 of the FERC's regulations, as amended. This self-certification as a QF will be required regardless of the voltage at the POI.

Exception: Self-certification requirement above is waived for GFs that are: 1) installed in Behind the Meter/R-DER installations, and 2) not expected to ever produce more energy from the GF than is consumed by the host Customer's facility on any 12-month calendar basis.

The links to FERC for "Frequently Asked Questions" and "Form 556" are listed below:

www.ferc.gov/about/what-ferc/frequently-asked-questions-faqs/qualifying-facilities-qf-faq

www.ferc.gov/industries-data/electric/resources/industry-forms/form-no-556-certification-qf-status-small-power

To be considered NON-FERC, the proposed GF (greater than 1 MW):

1. Must be a QF and must self-certify with FERC guidelines (refer to Section 3 of this document).
   Exception: Behind the Meter/R-DER projects are not required to self-certify as a QF.
2. May not exceed 80 MW of generation capacity.
3. APS shall be the off-taker of 100% of all produced generation.
4. Is voltage class agnostic (below 69 kV).

   NOTE: If at any time the QF changes any of the above conditions, it will need to be re-evaluated by APS for applicability. Customer shall notify APS and reapply if any of the above conditions change.

Due to relay coordination and potential Backfeed problems, APS cannot permit any DG with an AC nameplate output rating of greater than 10 kW to be connected to a Primary or Secondary Network System, or to a Customer SES electrically fed via an APS-owned distribution feeder Automatic Transfer Switch (ATS) without a detailed Interconnection Study being undertaken at Customer's expense to determine, among other things, special relaying, communication channels and other operational constraints that need to be implemented. A DG connected to either a Primary or Secondary Spot Network system will nonetheless not be permitted to Backfeed any power into the APS System.

The minimum protective and safety devices (relays, circuit breakers, disconnects, etc.) specified must be installed and placed into service before allowing parallel operation of Customer's GF with the APS System. These devices isolate Customer's generating equipment from the APS System whenever faults, over-current conditions, or disturbances occur, as well as for maintenance purposes. Modifications to the APS electrical system configuration or protective equipment may also be required at the expense of Customer in order to accommodate parallel generation.

APS will not assume any responsibility for the protection of Customer's generator(s), or of any other portion of Customer's electrical equipment. Customer is fully and solely responsible for protecting its equipment in a manner to prevent any faults or other disturbances from damaging, or otherwise adversely affecting, the operation of Customer's equipment.

In addition to complying with all required codes, ordinances and statutes, Customer must obtain an electrical permit and inspection indicating that Customer's GF complies with the NEC, as adopted by the AHJ. In the event that a Customer's GF is located in a locality where there is no AHJ, or the AHJ does not issue a permit or perform an inspection of the GF, then Customer will be required to

sign a “Letter-in-Lieu of Electrical Clearance.” APS will forward this letter for Customer’s notarized signature.

APS can disallow the interconnection of a Customer’s GF if, upon review of Customer’s design, or as the result of a Site Inspection, it determines that the proposed design is not in compliance with applicable safety codes, as it could constitute a potentially unsafe or hazardous condition.

If APS believes that there may be a potential safety issue or code violation, then APS reserves the right to forward the GF diagrams to, and/or discuss same with, the AHJ.

4 DISTRIBUTED GENERATION TYPES

Distributed generators include induction and synchronous electrical generators as well as any type of Static Inverter capable of producing AC power. A **Separate System** is one so designed that the generation never interconnects (operates in electrical parallel) with, or is capable of ever Backfeeding, the APS System. A **Parallel System** is one where a Generator can electrically parallel, or has the potential to be paralleled, with the APS System. Such parallel operation may be performed either on a momentary or on a continuous basis. Note that Backup Generators as defined in Section 2 of this document are not subject to ACC Interconnection Rules.

Customer may elect to configure its Generator as a Separate System with open transition transfer of load between two independent power systems as described in Section 4.1, or Customer may configure its Generator to run in parallel with the APS System as is described in Section 4.2.

4.1 Separate System

A Separate System is one in which there is no possibility of electrically connecting or paralleling a Backup Generator with the Utility System, or of a Backup Generator otherwise posing a potential risk of Backfeeding the Utility System. Load must be transferred between the two power systems by utilizing a Transfer Switch specifically designed to operate in an Open Transition Transfer mode. The Transfer Switch must always disconnect the load from the APS System prior to connecting it to the Generator. Conversely, the Transfer Switch must also disconnect the load from the Generator prior to re-connecting it with the APS System. These requirements apply to both actual emergency operations as well as to testing the Generator.

The Transfer Switch shall satisfy either one of the following design conditions:

(1) It must be tested and certified to UL 1008 (or UL 1008A), and/or

(2) It must be a true double-throw, fail-safe mechanical throw-over design which inherently precludes any possibility of the Utility and Generator sources from ever being connected together, even in the event of a switch failure such as welded contacts at one of the power source switch contacts. Note that a Transfer Switch or Transfer Scheme comprised of two interlocked electrical breakers or contactors will not meet this requirement, irrespective of how they may be interlocked. The Transfer Switch, for the purpose of qualifying as a Separate System as outlined in this Section, shall be of the manually operated type, and shall be tested and certified to UL 98.

In addition to meeting either of the design conditions specified above, the Transfer Switch installation shall also meet the following requirements in order to qualify as a Separate System:

(1) The Transfer Switch must be a permanent installation in the facility and must be inspected by the AHJ.

(2) The normal source (utility) electrical conductors and the emergency (generator) electrical conductors feeding the Transfer Switch shall not be routed in the same conduit or raceway or in any way share a common enclosure except inside the approved Transfer Switch.

An Open Transition Transfer Switch or Scheme that does not satisfy the requirements for a Separate System as outlined above constitutes a potential Backfeed source to the APS System. As such, APS has certain requirements that must be adhered to. These are described in Section 13 of this document. Also, refer to Section 104.11 of the APS ESRM for further details.

If Customer claims a Separate System, Customer shall submit an Application along with associated Supplementary Information for APS review and acceptance. Refer to the Appendix A and the APS Interconnection Application Process Guide available at www.aps.com/dg for additional details.

NOTE: Portable generators are normally not designed to be connected to a building's permanent wiring system, and are not to be connected to any such wiring unless approved Source Transfer Equipment is used and the installation is inspected by the AHJ. Opening a source circuit breaker or disconnect (such as the main breaker in an SES) in order to connect a portable generator is prohibited. Failure to use approved Source Transfer Equipment can result in Backfeed into the APS System – the generator voltage can be stepped up to a very high voltage through the APS transformer. This can pose a potentially fatal shock hazard to anyone working on the Utility power lines or equipment.

4.2 Parallel System

In a Parallel System, a Generator is connected to a bus common with the APS System, and a transfer of power between the two systems is a direct result. A consequence of such interconnected operation is that Customer's Generator must be considered in the electrical protection and operation of the APS System.

A Parallel System encompasses any type of Generator or GF (including ES systems) that can electrically parallel with, or potentially Backfeed the APS System. This includes any GF using a Closed Transition Transfer Switch or Transfer Scheme as well as any Static Inverter that can be configured or programmed to operate in a "utility interactive" mode.

The ACC Interconnection Rules, A.A.C. R14-2-2603, designate two system configurations for operation in parallel with the APS System:

1. Exporting System
2. Inadvertent Export System

APS has specific interconnection, inspection and contractual requirements, as outlined in this document that must be complied with and information that needs to be submitted for all interconnected generators. These requirements include a "visible open" Utility Disconnect meeting certain requirements to isolate Customer's System from the APS System, as well as protective relaying, metering, special rate schedules, and other safety and information requirements. Customer will be responsible for having the GF protective schemes tested by a qualified testing/calibration company. APS personnel will inspect the system and Customer will be required to sign an Interconnection Agreement and, if applicable, an Electric Supply/Purchase Agreement with APS.

In certain instances, APS and Customer will need to sign a Non-Parallel Connection Agreement and/or an Operating Agreement. APS will advise Customer of requirements after reviewing the proposed design.

NOTE: A Non-Parallel Connection Agreement will be required for GFs declared as Non-Exporting Systems as described in A.A.C. R14-2-2603 of the ACC Interconnection Rules. Such GFs have the capability, but will not operate in electrical parallel with the APS System, and will not require a Production Meter as noted in Section 9 of this document.

APS does not extend "blanket approval" to any specific type of Generator or generation scheme since each project is site specific and needs to be reviewed on a case-by-case basis.

In addition to the various other requirements specified in this document, parallel systems shall specifically comply with the technical requirements outlined in the interconnection technical requirements (Section 8) of this document.

5 CUSTOMER RESPONSIBILITIES

5.1 Facilities and Costs

The Customer is responsible for all facilities required to be installed solely to interconnect the Customer's GF to the APS System. This includes connection, transformation, switching, protective relaying, metering and safety equipment, including a visible open Utility Disconnect and any other requirements as outlined in this document, the ESRM and applicable rate schedules as well as any other special items specified by APS. All such Customer facilities are to be installed by the Customer at the Customer's sole expense. In the event that additional facilities are required to be installed on the APS System to accommodate the Customer's generation, APS will install such facilities at the Customer's expense. APS may also charge the Customer for any administrative costs and/or the costs of studies required to interconnect the Customer's generation.

5.2 Ownership

Customer will own and be responsible for designing, installing, operating, and maintaining:

(A) The GF in accordance with the requirements of all applicable electric codes, laws and governmental agencies having jurisdiction.

(B) Control and protective devices, in addition to minimum protective relays and devices specified in this document, to protect its facilities from abnormal operating conditions such as, but not limited to, electric overloading, abnormal voltages, and fault currents. Such protective devices must promptly disconnect the GF from APS's System in the event of a power outage on the APS System. (See APS Service Schedule 2.)

(C) Interconnection facilities on Customer's premises that may be required to deliver power from Customer's GF to the APS System at the POI.

5.3 Insurance

(A) Recommendation

Due to risks associated with interconnecting and operating a GF with the APS System, such as serious bodily injury, death, or property damage, it is recommended that every Customer protect itself with insurance or other suitable financial instrument sufficient to meet its construction, operating and liability responsibilities. A Customer should consult with its insurance advisor to determine what issues may be posed by the installation of the GF, since current policies may not have contemplated its addition, and changes may need to be made to the existing insurance policy to include coverage of the GF itself and the consequences of its operation. APS does not require that the Customer negotiate any policy or renewal of any policy covering any liability through a particular insurance provider, agent, solicitor, or broker.

(B) Requirement

Unless directed otherwise by APS, any Customer operating a Rotating Machine(s) with an aggregate AC output nominal nameplate rating of greater than 50 kW shall, at its own expense, maintain in force general liability insurance with a limit of $1,000,000 per occurrence and an umbrella or excess liability insurance policy with a limit of no less than $10,000,000 per occurrence. The insurance policies shall name APS as additional

insured and shall not contain any exclusion for liabilities related to the interconnection undertaken pursuant to the Interconnection Agreement. The amount of insurance shall be sufficient to insure against all reasonably foreseeable direct liabilities given the size and nature of the GF being interconnected, the interconnection itself, and the characteristics of the system to which the interconnection is made. Customer shall be required to obtain additional insurance, only if necessary, as a function of owning and operating a GF. Insurance shall be obtained from an insurance provider authorized to do business in Arizona. Certification that insurance is in effect shall be provided upon APS's request, except that Customer must show proof of the insurance to APS no later than ten (10) business days prior to the date upon which the GF commences interconnected operation with the APS System. If Customer is determined by APS to be of sufficient creditworthiness, Customer may propose to self-insure for liabilities.

5.4 Agreements

Interconnected Customers shall be required to sign an Interconnection Agreement in addition to any other agreements that may be applicable.

Customers that connect a backup or emergency generator with an open transition transfer scheme shall be required to sign a Non-Parallel Connection Agreement with APS. Unlike a UL 1008 transfer switch, a transfer scheme does not satisfy the requirements for a Separate System as outlined in Section 4.1.

Customers that connect a static inverter to the Utility, and which will be programmed so as not to Backfeed into the Utility System (i.e., non-utility interactive mode), will need to sign a Non-Parallel Connection Agreement with APS, since such an arrangement can constitute a potential Backfeed source.

Customers that purchase power from, or sell power to, APS may be required to sign an Electric Supply/Purchase Agreement.

Customers that connect at primary service (**above 600Vac Utility service**) will need to sign an Operating Agreement with APS.

In the event Customer wishes to modify, reduce, expand and/or add to an existing Interconnected GF (e.g., addition of a grid interactive battery backup system), the Customer shall submit a new Interconnection Application and associated diagrams in accordance with Section 16 of this document.

5.5 Multiple Services

In the event that Customer's facility is fed by more than one APS electrical service, Customer shall:

(A) Have controls and operating procedures that are acceptable to APS to ensure that services will never be paralleled; and

(B) Ensure that the GF is never connected to an electrical service other than the one specified in Customer's Interconnection Application and/or Interconnection Agreement. Additional information is given in Section 104.12 "Protection and Isolation Requirements for Multiple Utility Services to a Customer Facility" of the APS ESRM.

6 MUTUAL UNDERSTANDINGS

6.1 Interconnections

APS will not install or maintain any lines or equipment on a Customer's side of the POI, except it may install electric meters and at times research equipment. Only authorized APS employees (with credentials to identify their company affiliation) may make and energize the service connection between the APS System and Customer's service entrance conductors.

6.2 Easements and Rights of Way

Where an easement or right of way is required to accommodate the interconnection, Customer must provide to APS suitable easements or rights of way, in APS's name, on the premises owned, leased, or otherwise controlled by Customer. If the required easement or right of way is on another's property, Customer must obtain and provide to APS a suitable easement or right of way in APS's name, at Customer's sole cost and in sufficient time to meet the Interconnection Agreement requirements. All easements or rights of way must be on terms and conditions acceptable to APS.

6.3 Rate Schedules

The rate applicable to the interconnection of a Customer's GF will depend on the system size, type and configuration. Refer to Section 10 of this document for the rate schedules applicable to Distributed Generation. Because of varied and diverse requirements and operating modes associated with the interconnection, Customer must evaluate and determine which system configuration and electric rate is most appropriate and if it qualifies for the particular rate. Customer remains fully responsible for such matters; APS assistance or information should not be taken as constituting any representation or warranty about any particular option.

Any energy purchases from Customer's facility will be in accordance with the rate schedule and/or an Electric Supply/Purchase Agreement, any changes required by law or regulation, and rates authorized by law. GFs with requirements of unusual size or characteristics may require special rate and contract arrangements.

6.4 ACC Jurisdiction

The rates, terms or other contract provisions governing the electric power sold to a Customer by APS, purchased from Customer by APS, and Interconnection of DG by Customer with the APS System as noted within ACC Interconnection Rules, A.A.C. R14-2-2602 are subject to the jurisdiction of the ACC. APS retains at all times and without restriction the right to file a unilateral ACC application for a change in requirements, charges, classification, or service, or any rule, regulation or agreement as allowed by law.

7 *RESERVED*

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8 INTERCONNECTION TECHNICAL REQUIREMENTS

The requirements and specifications outlined in this Section are applicable to DG interconnected for parallel operation (continuous or momentarily) with the APS System, unless otherwise specified. The protection and safety devices and other requirements specified in this Section are intended to provide protection for the APS System and its workers, other APS Customers, and the general public. They are not intended to provide protection for Customer's generation equipment or personnel. This is the sole responsibility of Customer.

With respect to protection objectives, it is necessary to disconnect a Generator operating in parallel with the APS System when trouble occurs. This is to:

1. ensure if a fault on the APS System persists, the fault current supplied by Customer's Generator(s) is interrupted;
2. prevent the possibility of reclosing into an out-of-sync isolated (islanded) system composed of the APS System, or a section thereof, and Customer's Generator(s);
3. prevent reclosing the utility source onto Customer's GF that may be out of synchronism or stalled;
4. prevent unintentional islanding.

The protection requirements are minimal for smaller installations, but increase as the size of Customer's generation increases. Small installations usually ensure that the Generator is small compared with the magnitude of any load with which it might become isolated. Thus, for any fault on the Utility System, utility protective devices will operate and normally isolate the generation with a large amount of load, causing voltage collapse and automatic shutdown of the Generator.

Section 11, Additional Requirements for GFs with an Aggregate AC Generation $\geq$ 1 MW, contains requirements that apply to any GF that is nominally rated to generate 1 MW or more and is interconnected with the APS System for continuous parallel operation.

For larger installations, the probability of isolated operation is higher since the available generation may be sufficient to carry the entire load, or part thereof, of the local APS circuit. In instances where the APS System arrangement is that it is possible that the generators will not always be isolated with comparatively large amounts of load, additional protection and generator shutdown schemes are required.

Customer is solely responsible for the protection of its equipment from automatic reclosing by the Utility. APS normally applies automatic reclosing to overhead electric distribution circuits. When the APS source breaker trips, Customer must ensure that its generator is disconnected from the Utility circuit prior to automatic reclosing by the Utility. The automatic reclosing on APS distribution feeders is normally delayed by at least 2 seconds. Automatic reclosing out-of-sync with Customer's Generator may cause severe damage to Customer equipment and could also pose a serious hazard to Customer or Utility personnel.

8.1 General Technical Requirements

(A) Compliance

Customer is responsible for obtaining and maintaining all required permits and inspections indicating that Customer's GF complies with all applicable codes, ordinances and statutes relating to safety, construction and operation.

(B) Multiple Generators

Multiple Generator connections on the same Utility service are permitted subject to APS approval; however, a single Utility Disconnect for the GF will generally be required (normally located at the SES) unless agreed upon by the Customer and APS. If APS approves more than one Disconnect behind a Utility service, then the Disconnect shall be labeled per Section 8.6(B).

(C) Transfer Trip

The study process may determine the need for transfer trip.

A transfer trip scheme, and in some instances a Dedicated Utility Feeder, shall be required at customer expense if the Generator or aggregate Generators:

(1) Are of sufficient size to carry the (minimum) load of APS's distribution feeder, or

(2) Size or physical feeder location could support an isolated (islanded) section of the feeder

If a transfer trip is required, or Customer's aggregate generation is one MW or greater, a communication channel and telemetering will also be required. The transfer trip scheme shall utilize the GF main breaker. These will be at Customer's expense. Refer to Sections 11 & 16.7 for additional information. In such instances, APS will need to perform an Interconnection Study to determine required facilities.

(D) Potential Open Point

Whenever a Generator is configured to operate in electrical parallel with the Utility grid, Customer shall ensure that any Potential Open Point (Open Point) located in the circuit between the Generator output and the Utility service is suitably interlocked to preclude the possibility of a potential out-of-sync closure occurring between the power sources. A Potential Open Point includes any circuit breaker, contactor, switch, etc., that is capable of being opened and/or closed, and which is not equipped with either a sync check or synchronizing function. A Potential Open Point may be interlocked by installing either of the following:

(1) An electrical interlock consisting of a set of electrical contacts on the Open Point, which are directly wired to instantaneously trip open a circuit breaker in the circuit, which is equipped with either a sync check or synchronizing function, whenever the Open Point is opened. This breaker, upon opening, shall immediately break the electrical path between the power sources.

(2) A keyed or other suitable mechanical interlock that will prevent the Open Point from ever being opened unless a circuit breaker in the circuit, which is equipped with

either a sync check or synchronizing function, is first opened. This breaker, when opened, shall immediately break the electrical path between the power sources.

NOTE: An exception can be made to this requirement for a Generator with built in anti-islanding protection that cannot be easily bypassed, circumvented and/or disabled. Additionally, APS could consider an intertie relay as a means of meeting these requirements that would trip off the Generator breaker (or breakers) in the event a Potential Open Point was operated and/or a grid outage occurred.

(E) Production Metering

If APS is required to install electric meter(s) to record the output of Customers Generator(s), Customer shall ensure that the design is such that the meter(s) are located on the utility side of any Generator breaker on a normally energized bus. Electronic meters are not designed to be de-energized for any length of time.

(F) Supply Side Connection

If a Generator is connected or tapped on the supply (utility) side of an SES service disconnecting means, as may be permitted by the NEC, the installation is subject to all applicable NEC requirements and/or requirements adopted by the AHJ. The Tap is on the load side of the APS billing meter and ahead of the main service disconnect(s) to ensure that the billing meter registers net energy flow. The required disconnecting means shall also be in accordance with the APS ESRM.

(1) A Supply Side Connection (SSC), also referred to as a Line Side Tap, constitutes a new service as defined by the NEC, and is subjected to all applicable NEC requirements and/or requirements adopted by the AHJ. In addition, any such connection must comply with the APS ESRM and Good Utility Practice. The required SSC service disconnecting means shall also be in accordance with the APS ESRM. Any SSC shall be made without any modifications to any factory installed and/or UL listed equipment or components, unless expressly authorized by the panel manufacturer and/or listing agency. It must be performed in strict accordance with the panel manufacturer's directions and specifications. In order for APS to approve an SSC interconnection, the following are required:

a. Rigid Metal Conduit (RMC) shall be used between the SSC connection in the SES and an externally mounted (external to the SES) SSC fused service disconnect (SSC Service Disconnect).

b. The ampere rating of the conductor feeding an SSC Service Disconnect shall not be less than #2 AWG Cu or the ampere rating of the SSC Service Disconnect, whichever is larger, unless determined otherwise by APS. The minimum ampere rating of the SSC Service Disconnect shall be 60 A per NEC Art 230.79(D).

c. The SSC Service Disconnect shall be mounted "immediately adjacent" to the SES, 10 feet or less per NEC Art 705.31, located on the same wall. The circuit shall not be routed through any other enclosures (i.e., junction boxes and/or distribution panels) between the SES and the SSC Service Disconnect. Workspace and elevation shall be in accordance with Section 8.2(C) of this document. If it is necessary to go beyond the 10-foot maximum requirement,

there is an allowance under NEC Art 705.31 for current limited circuit breakers or cable limiters to be installed at the tap point.

d. A neutral to ground (N-G) bond must be re-established in the SSC Service Disconnect, and GEC installed. Note however, that if the SSC is made via a breaker or fused disconnect located within the SES (i.e., not an externally mounted service disconnect), then the existing N-G bond will suffice. The grounding electrode conductor must be connected to the neutral bus (not the ground bus) in the SSC Service Disconnect and existing SES per NEC Art 250.24(A)(1) and exhibits in the code handbook.

e. If panel manufacturer authorization is granted to perform an SSC, proof of such authorization and AHJ approval shall be provided to APS as part of the Interconnection Application process.

i. No drilling, tapping or replacing of factory installed bus bars or conductors unless performed by the manufacturer or its designated representative. If the UL is voided the equipment must be replaced or a field evaluation is required*

ii. If lugs are replaced to accommodate additional conductors, the panel manufacturer must specify a listed kit or provide written approval of the parts to be used. Appropriate torque specs shall also be provided.

iii. When connecting to a field installed conductor a UL listed tap should be used. Breaking the conductor should be avoided – using a lay in lug is preferred. The connector's make and model number should be provided.

iv. Fused and unfused conductors shall not occupy the same raceway unless they are isolated from each other via a firewall barrier in a manner acceptable to APS.

v. Bonding jumpers per NEC Art 250.92(B) shall be installed around reducing washers and any eccentric or concentric fitting knockouts remaining.

vi. **Exception:** If panel manufacturer does not grant permission and/or have a kit to perform the Tap required, a field evaluation is required in order to perform the SSC*.

- **Note:** In this case, the Customer shall provide APS the Letter of Compliance issued to the NRTL certified by OSHA to perform the evaluation (i.e., CSA, TUV, UL, etc.) as well as a photograph of the approval sticker affixed to the SES at the time the work is completed in the field. A full list of authorized NRTL program providers can be located at www.osha.gov/dts/otpca/nrtl/nrtllist.html.

f. Per NEC Art 225.32, the Service Disconnect shall be Readily Accessible.

g. Per NEC Art 240.24(B), all over-current devices protecting the conductors supplying the premises shall be Readily Accessible to the occupant.

(2) No Customer connections or equipment are permitted in the Utility sealed metering compartment or pull-section of the SES. Any SSC shall be made in either (a) the

applicable Customer accessible section of the SES (e.g., large system switchgear) or (b) a field installed NEMA 3R rated gutter or tap box (applies to meter-main or main-lug-only), and a label shall be placed at the SES in accordance with Section 8 of this document. Exception: Interconnection equipment such as a utility or customer-owned Meter Socket Adapter (MSA) interconnecting power production or whole home electric isolation and (intentional or unintentional) islanding of a Generating Facility shall be allowed where that device does not impede access to the sealed meter socket compartment or pull section of the sealed compartment of the Service Entrance Section (SES). The MSA shall meet the established MSA guidelines published listed in section 8.1.h of this document.

(3) APS secondary electrical service conductors are not fused and can only be de-energized by APS personnel. Customer will need to contact APS to arrange for the electrical service to be de-energized prior to performing an SSC. Since APS will not re-energize the service following completion of the SSC unless an electrical clearance (green tag) has been issued by the AHJ, it is important that Customer coordinate this work very closely with APS and the AHJ. In an area where there is no plan review or permit requirement imposed by the AHJ, a Third-Party Inspection is required to be completed with any/all corrections addressed by Customer Representative. In addition, the final report will be submitted to APS upon request.

(4) The maximum output current nameplate rating of the Generator(s) shall not exceed the 100% continuous duty rating of the APS transformer or service run. Note that the ratings of the APS transformer and service run do not necessarily match the SES rating. APS will notify Customer if any APS equipment is over-dutied following APS review of the Interconnection Application. Any required equipment upgrades shall be performed at Customer's sole expense.

(G) Load Side Tap

A Load Side Tap constitutes a tap as defined in this document, and is subject to all applicable NEC requirements and/or requirements adopted by the Authority Having

Jurisdiction. In addition, the connections must comply with the APS ESRM and Good Utility Practice.

The following requirements were prepared for applications where a generator is tapped on the load side of the main service disconnect:

(1) The Tap originating from the SES shall terminate at an accessible and lockable overcurrent protective device in accordance with NEC Art 240.4.

(2) For Tap Conductors 10 ft. or less (distance between SES and first overcurrent device), conductors shall be sized per NEC Art 240.21(B)(1).

(3) For Tap Conductors 25 ft. or less (distance between SES and first overcurrent device), conductors shall be sized per NEC Art 240.21(B)(2).

(4) The Tap shall be made without altering any factory installed bus bars or conductors unless performed by the manufacturer or its designated representative.

   a. No drilling, tapping or replacing of factory installed bus bars or conductors unless performed by the manufacturer or its designated representative.

   b. Bonding jumpers per NEC Art 250.92(B) need to be installed around reducing washers and any eccentric or concentric fitting knockouts remaining.

   c. Insulation piercing and threaded lug type connectors are allowed as long as they are protected by overcurrent protection devices on both ends.

   d. If lugs are replaced to accommodate additional conductors, the panel manufacturer must specify a listed kit or give written approval of the parts to be used. Appropriate torque specs shall also be provided.

   e. When connecting to a field conductor a UL listed tap should be used. Breaking the conductor should be avoided – using a lay in lug is preferred. The connector's make and model number should be provided.

(5) Exception: If panel manufacturer does not grant permission and/or have a kit to perform the Tap required, a field evaluation is required in order to perform the tap connections. In this case, the Customer shall provide APS the Letter of Compliance issued to the NRTL certified by OSHA to perform the evaluation (i.e., CSA, TUV, UL, etc.) as well as a photograph of the approval sticker affixed to the SES at the time the work is completed in the field. A full list of authorized NRTL program providers can be located at www.osha.gov/dts/otpca/nrtl/nrtllist.html.Per NEC Art 225.32, the overcurrent protective device shall be Readily Accessible.

(6) Per NEC Art 240.24(B), all overcurrent devices protecting the conductors supplying the premises shall be readable accessible to the occupant.

(7) Per NEC Art 250.122(G), the equipment grounding conductor run with the tap conductors shall be sized per the SES Main overcurrent setting but shall not be required to be larger than the tap conductors.

   NOTE: For a typical Load Side Tap installation, APS requires a two disconnect configuration. The first disconnect is fused and constitutes the Customer Fused

Disconnect as required by the NEC. The second disconnect is the Utility Disconnect required by APS.

(H) Interconnection System Equipment

Interconnection equipment such as a utility or customer-owned Meter Socket Adapter (MSA) interconnecting power production or whole home electric isolation and (intentional or unintentional) islanding of a Generating Facility shall be allowed where that device does not impede access to the sealed meter socket compartment or pull section of the sealed compartment of the Service Entrance Section (SES). The MSA shall meet the requirements listed below:

Interconnection equipment, such as a utility- or customer-owned Meter Socket Adapter (MSA), which is used to interconnect power production, energy storage, or whole-home electric isolation and (intentional or unintentional) islanding of a Generating Facility, shall be allowed where that MSA device does not impede access to the sealed meter socket compartment or pull section of the sealed compartment of the Service Entrance Section (SES). The following requirements apply to the use of an MSA for interconnection:

(1) MSAs must be UL 414 certified, and rated adequately for the connected equipment.
(2) The MSA must be installed, either, by APS or by a certified licensed and qualified professional electric contractor with an active electrical contractor license, R-11 or CR-11, including any subcontractors.
(3) APS residential customers shall be eligible to install an MSA if all of the following requirements are met:
    a. A self-contained electric meter panel not exceeding a 200 amp rating, as determined by APS, and a single phase 120/240 volt electric service is installed.
    b. Subject to exceptions approved by APS, the main breaker and meter socket are contained in the same electrical panel.
    c. An electric meter panel that meets all APS requirements and passes an initial review before the installation. The panel must also pass an evaluation by APS personnel or an APS-approved contractor.
    d. The customer's solar generating system, including an energy storage system if installed, connected to the MSA shall have a rating consistent with the specified fault currents in Table 800.2 of the APS Electric Service Requirements Manual (per NEC Art. 110.9 & 110.10). Additionally, the service disconnecting means of the MSA shall meet NEC Art. 230.79.
    e. Any existing customer generation or energy storage sources on the property that are interconnected with the APS service are identified on the interconnection application and submitted drawings.
    f. The local Authority Having Jurisdiction has issued a permit for the installation of your generation system (or energy storage system) and the supply (or line) side connection to the MSA.
    g. All customer-owned electrical equipment, including MSAs, must satisfy the meter clearances specified in the APS Electric Service Requirements Manual.

h. As applicable for the purposes of carrying current back to the utility distribution system, the wire between the fused disconnect switch and the MSA must be insulated copper wire, sized at AWG 6 gauge, and rated for 90° C.
i. Bond an Equipment Grounding Conductor from the Disconnect Switch and connect to the Service Grounding System; typically, #6 AWG copper, bare.

For the avoidance of doubt, an MSA is not allowed to be installed on electric panels that:

- have deteriorated parts,
- are rated above 200 amps,
- do not meet the equipment clearances,
- are located on poles or inside cabinets,
- have an overhead to underground service adapter,
- are a stand-alone meter socket attached to a stem wall or uninstalled separate from a residential building or structure at which service is delivered, or
- where the MSA and/or wires cannot be routed and terminated appropriately.

(I) Prior to Ordering Equipment

Customer is responsible for the design, installation, operation and maintenance of all equipment on Customer's side of the POI. It is strongly recommended that Customer submit specifications and detailed plans as specified in the Interconnection Application (refer to the APS Interconnection Application Process Guide available at www.aps.com/dg) for the installation to APS for review and written acceptance prior to ordering any equipment. Customer shall not energize or interconnect the distributed energy generation system until the Utility approves the application. See Arizona Revised Statute 44-1764 (Title 44 Section 11). Written acceptance by APS does not indicate acceptance by other authorities.

(J) Conductors

While APS recommends the use of copper conductors, if Customer nonetheless elects to use aluminum conductors to connect any equipment either owned by, or placed under operational jurisdiction of APS (GF metering, Utility Disconnect, etc.), then Customer must comply with the following requirements:

(1) An oxidation inhibitor must be applied to the cleaned aluminum conductor.

(2) A UL Listed 2-hole bolted lug, compression type terminal, must be used for the terminations of the aluminum conductors.

(3) Compression terminal shall clearly indicate the conductor and the die to be used on the crimping tool, and the connection shall be made in strict accordance with manufacturer specifications.

(4) Locations of aluminum conductors must be clearly identified on the Interconnection Application diagrams submitted to APS for review.

APS will not assume any responsibility for any maintenance or inspection of conductors within an APS sealed portion of the GF. It shall be the sole responsibility of Customer to schedule and arrange for any such inspection.

8.2 Utility Disconnect (Disconnect)

Customer shall install and maintain a visible open, manually operated, load break disconnect that will completely open and isolate all ungrounded conductors of Customer's GF from the APS System. For multi-phase systems, the disconnect shall be gang-operated.

The Disconnect shall comply with the following additional requirements:

(A) Visible Open and Lockable Requirements

The Disconnect shall be visible-open such that the blades, jaws and the air-gap between them shall all be clearly visible when in the "open" position and the front cover is opened, in accordance with NFPA-70E Section 120.5 Process for Establishing and Verifying an Electrically Safe Work Condition. It is not acceptable to have any of the "visible open" components obscured by a "dead front" or an arc-shield, etc. Only disconnects specifically designed to provide a true "visible open" are acceptable.

The disconnect handle shall be capable of being locked in the "open" position by a standard APS padlock with a 3/8" shank. The front cover shall be kept locked at all times in accordance with NEC 110.31(D) and OSHA 1910.303(h)(2)(v)(D). The front cover hasp shall be capable of accepting a 3/8" shank padlock, and shall not be field modified in any way.

If a second service disconnecting means is required to be installed as in the case of a SSC, the second service disconnect cover shall be locked closed with a customer provided lock. In the event Customer installs additional disconnects which are separate from the APS required Utility Disconnect, the covers of any such shall be locked closed with a customer provided lock.

Consult manufacturer representative for list of APS approved visible open disconnects.

(B) Disconnect Connection

The Disconnect shall be connected so that the blades (and any fuses if present) are de-energized when the disconnect is in the "open" position in accordance with OSHA 1926.405(C), NEC 404.6(C) and NFPA 70E. For example, the blades (load side) will be connected to the inverter side of a Static Inverter based circuit and the jaws (line side) to the utility source side.

The Disconnect shall be located on the utility source side of any meter installed to measure the output of the GF Generator(s) (i.e., Production Meter).

(C) Disconnect Location

The Disconnect shall be installed in a Readily Accessible location (easily accessed by APS on a 24-hour basis – refer to definition) so as to provide safe (no tripping hazards, domesticated animals or other obstructions, etc.) and easy, unrestricted and unimpeded access to APS personnel. It must be installed adjacent to the Customer's SES; however, subject to APS' express approval, it may be located in the immediate vicinity of the Customer's Generator, provided that APS' access to the Disconnect is not impeded.

The Disconnect shall be installed in accordance with all applicable NEC and APS requirements. It shall be located between 36" and 60" measured from final grade to the center of the disconnect and include a minimum clear working space of 36" by 36" in front of the disconnect. The required working space may be greater than 36" by 36" (e.g., NEC Article 110 requirements). The Disconnect shall not be:

(1) located behind an electrically operated gate or door unless the electric operator is backed up by an uninterruptible power source to ensure that it can be operated in the event of a Utility power outage.

(2) installed under a breezeway, patio, porch or any area that can be enclosed.

(3) installed behind a gate, fence, wall or other barrier.

(4) mounted to a non-permanent structure (including a masonry wall, fence, etc.) unless utilizing service support specifications as noted in Section 306.0 of the APS ESRM.

NOTE: APS may grant an exception to commercial Customers who locate equipment (i.e., APS Utility Disconnect) behind a locked door or gate as long as the equipment is installed in a safe location (no tripping hazards, domesticated animals or other obstructions, etc.). In this case, APS can provide a lock box to be installed by the commercial Customer for APS to gain access to the Disconnect or any other APS equipment. The lock box needs to be installed within 36" of the door or gate, etc., and it shall be located no less than 36" above grade and no more than 60" above grade. Indoor equipment locations require access from the exterior of the building.

(D) Electrical Ratings

The Disconnect must be rated for the voltage and current requirements of the Generating Facility, and must be listed and conform to all applicable UL, ANSI and IEEE standards. The disconnect shall be rated to withstand the available fault duty current and shall not be fused, unless expressly agreed to by APS. (Reference NEC Art 110.9, NEC Art 110.10, OSHA 1910.303(b)(4) and OSHA 1910.303(b)(5)). In the case where Customer installs a fused disconnect to limit the fault current a second unfused Disconnect for APS use will need to be installed subject to Section 8.2(C) above. In instances where a visible-open disconnect is not commercially available (e.g., due to a high system current), APS may accept a Customer installed rack-out breaker, along with a racking tool and grounding breaker (to ground the utility side) as may be required, in order to effect an electrical clearance or establish a safe working area. In these cases, APS will work with Customer to determine the best option and ensure that all appropriate safety requirements are met.

(E) Disconnect Grounding

The disconnect enclosure shall be properly grounded via an equipment ground wire attached to a factory provided grounding lug or an appropriately UL listed grounding lug or terminal.

In cases where the Disconnect will be installed on a line at a voltage above 600V, APS has specific grounding requirements that will need to be incorporated into the Disconnect in order to ground the phase conductors on the utility side of the disconnect when it is

necessary to establish a safe working area for APS personnel. Refer to the APS ESRM for further details. APS also has certain requirements that will need to be adhered to for the purpose of obtaining electrical clearances or establishing a safe working area, including the entering into an Operating Agreement with Customer.

(F) Disconnect Conductors

The Disconnect shall be a stand-alone device, and electrical conductors and/or cables entering into and exiting from the Disconnect shall be kept physically separated and shall not be routed in the same raceway or in any way share a common enclosure.

Under no circumstances shall the Disconnect enclosure be used as a conduit or raceway for any conductors other than those phase conductors being switched, the neutral (grounded conductor) and equipment ground (grounding conductor).

(G) Operational Jurisdiction

The Disconnect will be placed under the operational jurisdiction of APS for systems with a line voltage of 600V or less, and the cover of such disconnect will be locked closed with a standard 3/8" shank APS padlock following satisfactorily completion of the APS Site Inspection.

Under no circumstances shall the Disconnect be remotely operated or involved in protective schemes.

APS shall have the right to lock open, or cause to be locked open, the Disconnect without notice to Customer when interconnected operation of the Customer's GF with the APS System could adversely affect the APS System or endanger life or property, or upon termination of the Interconnection Agreement.

(H) NEC Rapid Shutdown of Photovoltaic Systems

For systems to be equipped with rapid shutdown:

(1) The Utility Disconnect(s) shall not be designated as the rapid shutdown initiation device(s).
(2) Rapid shutdown initiation shall not depend on the Utility Disconnect(s).
(3) Install according to applicable NEC and AHJ requirements.

8.3 Dedicated Service Transformers

The additional installation of a dedicated service transformer would be included in the cost of Interconnection. Dedicated service transformers shall be configured grounded-wye on the utility/high voltage side. The high-side grounding shall be accomplished via the installation of a ground strap connected from the H0 bushing to the ground reference.

(A) Dedicated Secondary Transformer

For secondary systems (600Vac Utility services and below), a GF may be required to be isolated from other Customers fed off the same utility transformer by a dedicated service transformer connecting to the utility distribution feeder. The primary purpose of the dedicated transformer is to ensure that (A) the generation cannot become isolated at the secondary voltage level with a small amount of other-Customer load, and (B) the generation does not contribute any significant fault current to other Customer's electrical systems. It also helps to confine any voltage fluctuation or harmonics produced by the

Generator to Customer's own system. APS will specify the transformer winding connections and any grounding requirements based on the specific Customer site location and generator type. This option is evaluated as part of the study process.

(B) Dedicated Primary Transformer

For primary systems (above 600Vac Utility service - i.e., multi megawatt power plants), dedicated service transformer configurations as noted herein apply to all transformer bank skids. Any exceptions would be studied on a case-by-case basis.

8.4 Power Quality

In order to minimize interference on the Utility System Customer must ensure that the electrical characteristics of its load and generating equipment meet, as a minimum, the specifications outlined below.

(A) Current Imbalance

The phase current imbalance for a three-phase system as measured at Customer's SES shall not be greater than 10% at any time. For further information, refer to APS Service Schedule 1.

(B) Harmonics

The electrical output of Customer's GF shall not contain harmonic content that may cause disturbances on or damage to the APS System, or other Customer's systems, not limited to computer, telephone, communication and other sensitive electronic or control systems. Harmonics, as measured at the POI, shall not exceed the limits promulgated in the latest version of IEEE 519.

(C) Power Fluctuations

Customer must exercise reasonable care to assure that the electrical characteristics of its load and generating equipment, such as deviation from sine wave form or unusual short interval fluctuations. It shall not result in impairment of Customer's service or service to other Customers, interference with operation of computer, telephone, television, other communication systems or facilities.

(D) Voltage Flicker

The voltage flicker level shall not exceed APS standards measured at the Customer's POI as outlined in the latest version of IEEE 519 and IEEE 1453.

(E) Service Voltage Ranges

The GF should not cause the RMS voltage at the POI to vary beyond the Favorable Voltage Service Range (Range A) of +/- 5% as specified in ANSI standard C84.1. APS may require the Customer to remedy any voltage excursion caused by the Customers GF at the POIor any point along the APS System and/or a neighboring customer's POI outside of this ANSI range, by implementing settings to the GF and agreed on by the Customer and APS at the time of interconnection, or in instances where voltage excursions is experienced..

8.5 Voltage Requirements

Customer generating equipment must be rated at 60 Hertz, and be either a single or three-phase system connected at a standard utility voltage that may be selected by Customer subject to Utility availability at the premises.

8.6 Labeling Requirements

(A) General Requirements

Customer shall conform to the NEC, as adopted by the local Authority Having Jurisdiction, for labeling of all GF equipment, including the SES. APS will assume responsibility for labeling any utility-owned equipment. All APS-required labels shall consist of a permanently attached weatherproof/UV resistant placard, letters shall be engraved or embossed/raised, and letters will be a minimum of 1/4 inch tall unless otherwise specified by APS. All Production Meter and Utility Disconnect labels shall be riveted. All other labels may use the 3M 4930 VHB two-sided adhesive tape. Labels shall be non-ferrous material made of (a) aluminum, brass or other approved corrosive resistant metal, or (b) a high-density polyethylene material 55 mils thick comprised of a 35 mil black polyethylene base film capped (co-extruded) with a 20 mil color polyethylene. Labels should follow the ANSI Z535.1-2011 color codes when applicable.

(B) Disconnect

Customer shall label the Disconnect "Utility Disconnect". In the event APS grants approval to install the Disconnect at a location other than the electrical SES: (1) Customer shall install a placard at the SES giving concise express directions to, and the location of, the Disconnect, and (2) Customer shall install a placard at the Disconnect giving concise express directions to, and the location of, the SES.

In the event APS allows more than one Utility Disconnect to be installed at a Customer's facility, the Disconnects shall be labeled 1/x, 2/x, etc. where x is the total number of Utility Disconnects. When more than one SES exists at a Customer's facility, the disconnect shall be labeled to reference the appropriate SES.

A warning label shall be mounted on the Disconnect front cover with the following words: "Warning: Electric Shock Hazard. Do Not Touch Terminals. Terminals On Both The Line And Load Sides May Be Energized In The Open Position."

Rapid Shutdown initiation device(s) as required in the NEC shall be identified on disconnecting device(s) other than the Utility Disconnect(s).

(C) Production Meter

Customer shall label the Production Meter enclosure and/or socket as "Uni-Directional Meter" or "Bi-Directional Meter". When more than one Uni-Directional or Bi-Directional Meter exists at a Customer's facility, the meters shall be labeled to reference the appropriate System such as "Bi-Directional Meter #1" and "Bi-Directional Meter #2", etc. In the event APS grants approval to install the Production Meter at a location other than the SES: (1) Customer shall install a placard at the SES giving concise express directions to, and the location of, the Production Meter, and (2) Customer shall install a placard at the Production Meter(s) giving concise express directions to, and the location of, the SES. When more than one SES exists at a Customer's facility, the meters shall be labeled to reference the appropriate SES.

Additionally, for metering maintenance, if load-side terminals may be energized by a DG source, a label shall be placed adjacent to or affixed to the Production Meter enclosure stating:

"Warning: Load side terminals may be energized by Backfeed."

(D) Service Entrance Section (SES)

When a DER system is connected on the supply (Utility) side of the SES main breaker, in accordance with the NEC and requirements specified in this document, a label shall be placed adjacent to the main service breaker stating:

"Warning: A Generation Source is connected to the Supply (Utility) Side of the Service Disconnecting Means. Follow proper Lock-Out/Tag-Out Procedures to ensure the Utility Disconnect is opened prior to performing work on this device."

(E) Meter Disconnect

Customer shall label the disconnect "Uni-Directional Meter Line Side Disconnect," "Bi-Directional Meter Line Side Disconnect," "Bi-Directional Meter DER Side Disconnect," etc. as applicable. See APS Sample and Concept Diagrams at www.aps.com/dg.

9 METERING REQUIREMENTS

This Section applies to any Generating Facility that electrically parallels with the APS System other than a Backup Generator.

9.1 Service Entrance Section Metering

Customer must provide and install, at Customer's expense, meter sockets and metering cabinets in accordance with APS service standards, in Readily Accessible locations acceptable to APS, to accommodate any meter(s) that are required by applicable rate schedule(s) or other APS agreement (e.g., Totalized Metering) or other APS requirements (e.g., EMS Meter). Such standards are specified in the APS Electric Service Requirements Manual (ESRM), available at the following website: www.aps.com/ESRM.

Metering Installation Requirements are addressed in Section 300 of the ESRM.

APS will furnish, own, install and maintain meter(s) located at the GF SES as required by APS, and any meter(s) that may be required by the applicable electric rate schedule to measure the output of the Generator(s). The responsibility for the costs of providing and maintaining any required meters and communication circuitry as required will be specified in the applicable rate schedule or other APS agreement. Refer to Section 9.3 of this document for Metering Communication requirements.

Any Metering provided by APS as described in this Section shall be located in appropriately sealed compartments, and no Customer wiring, connections, or equipment is permitted in any such APS sealed metering compartment or pull-section of the SES.

9.2 Production Metering Requirements

All Generating Facilities other than those comprising a Backup Generator must include provisions to allow APS to install an AMI type Production Meter (or Meters as the case may be). This Metering shall be configured to measure and record the AC energy production of the Generator(s).

Production from a Generating Facility must be associated with only one billing meter and shall be designed to offset the load associated with only that (billing) meter.

The Production Meter enclosure and associated equipment must be installed in compliance with Section 300 of the APS Electric Service Requirements Manual (ESRM), available on APS' website. A valid neutral is required for APS Metering to work properly.

Until such time that APS installs the APS-owned Production Meter, Customer has the option of either installing a Customer-owned "test meter" or an approved meter cover over the meter socket. **Under no circumstances is the meter socket to be left open or otherwise exposed at any time.** Once Customer notifies APS that the GF is ready for the APS site inspection and/or Production Meter installation, APS will schedule the installation of its Production Meter. APS will then remove any Customer installed test meter(s) or meter cover(s), install an AMI type Production Meter along with any associated metering equipment, and seal the meter socket ring and metering enclosure.

An approved meter cover will be a commercially available meter cover designed and approved by the manufacturer for outdoor use on meter sockets. It shall be constructed of materials such as fiberglass, rigid plastic, and glass. Note that a cardboard cover (typically

used for shipping purposes) is not an acceptable material. The meter cover shall be properly installed and sealed to the meter socket.

Under no circumstances shall any metering enclosure be used as a junction box, raceway, or wireway.

For Current Transformer (CT) rated installations (greater than 200A), APS will install the Production Meter, CTs, any PTs, test switches and required wiring. Customer shall be responsible for installing, in accordance with APS' requirements a ring type production metering enclosure with meter socket. Customer shall adhere to the following additional requirements:

(A) For Secondary Voltage systems (phase to phase voltage less than 600V) of 200A and less, Customer shall provide a ring type self-contained metering enclosure and a meter per the APS ESRM. Note that safety test blocks are not required for commercial (or residential) installations. For Secondary Voltage systems greater than 200A (with phase to phase voltage less than 600V), Customer shall provide a ring type CT rated enclosure per the APS ESRM.

(B) For Medium Voltage systems (phase to phase voltage 600V and higher), Customer shall provide a medium voltage lineup along with grounding provisions per the APS ESRM.

(C) For Static Inverter based Energy Storage Systems (i.e., battery backup systems), Customer shall provide production metering provisions in accordance with APS Sample Diagrams. Isolation on both sides of the ESS Production Meter is required for metering maintenance. In addition, the ESS Production Meter shall be labeled when load side terminals may be energized by a DG source in accordance with Section 8.6(C). The APS Sample Diagrams can be downloaded at www.aps.com/dg.

(D) Production Meter enclosures/sockets shall be labeled in accordance with Section 8.6 (C) of this document.

Customer shall provide and maintain communication circuitry depending on the applicable rate schedule or other APS agreement. Refer to Section 9.3 of this document for Metering Communication requirements.

All CT rated metering enclosures shall have the bus identified with reference to the generation source side prior to metering installation with a semi-permanent tag/mark labeled "Generation Source."

Customer must provide a suitable visible open disconnecting means, subject to APS' approval, to electrically isolate any CT rated meter from all potential sources of power. For meters installed on systems with a phase to phase voltage of 600V or higher, suitable grounding provisions shall also be required in accordance with the APS ESRM (Section 1100) and subject to APS approval.

All CT rated metering enclosures shall be submitted by equipment manufacturer through an APS Representative for review and approval by the APS meter shop in accordance with the APS ESRM. Submittal shall clearly indicate the points of connection of the Utility and Generator sources.

Drawing submittal shall include: engineering and manufacturer one-lines, manufacturer (name), EUSERC page references that are applicable, ampacity, physical dimensions,

voltage, phase, bus bracing (AIC rating), padlockable provisions, accurate address (street and number), GF system type, etc.

Such metering enclosure shall be tested and marked to withstand the available short circuit current (Reference NEC Art 110.9, NEC Art 110.10, OSHA 1910.303(b)(4) and OSHA 1910.303(b)(5)).

Production Meters shall be installed in a Readily Accessible location (available 24 hours) to provide safe (no tripping hazards, domesticated animals or other obstructions, etc.) and unrestricted access to APS personnel per APS Requirements. This includes but is not limited to Section 300 of the APS ESRM and Service Schedule 1 ("Terms and Conditions for Standard Offer and Direct Access Services"). Customer provided metering enclosures shall be installed adjacent to Customer's SES and disconnects unless otherwise approved by APS. The Production Meter shall not be:

(1) located behind an electrically operated gate or door unless the electric operator is backed up by an uninterruptible power source to ensure that it can be operated in the event of a utility power outage.

(2) installed under a breezeway, patio, porch or any area that can be enclosed.

(3) installed behind a gate, fence, wall or other barrier.

(4) mounted to a non-permanent structure (including a masonry wall, fence, etc.) unless utilizing service support specifications as noted in Section 306.0 of the APS ESRM.

NOTE: APS may grant an exception to commercial Customers who locate equipment (i.e., APS Production Meter and its associated disconnect(s)) behind a locked door or gate just as long as the equipment is installed in a safe location (no tripping hazards, domesticated animals or other obstructions, etc.). In this case, APS can provide a lock-box to be installed by the commercial Customer for APS to gain access to the Production Meter or any other APS equipment, the lock-box needs to be installed within 36" of the door or gate, etc., and it shall be located no less than 36" above grade and no more than 60" above grade. Note that any indoor equipment locations require access from the exterior of the building. A placard or directory must be installed at the SES with concise directions to, and the location of, the Production Meter(s) and associated Disconnect(s).

All metering disconnects shall adhere to the same requirements outlined in Section 8.2 as for the Utility Disconnect.

9.3 Metering Communication

Where the applicable rate schedule or other APS agreement requires billing meter(s) to be installed on the output of the facility Generators, Customer will provide acceptable meter sockets and/or enclosures in accordance with the APS ESRM. APS will install AMI meters to measure the output of the Generators. For Generating Facilities 1 MW and greater, APS has additional requirements for metering and associated communication. Refer to Section 11.4(C) of this document for more information.

In the event that it is not possible to install AMI meters, Customer will be required to provide a dedicated analog dial tone phone line to each Production Meter and also to the GF SES utility meter(s) and/or sub meters if necessary. Each dedicated phone line is to be landed on the APS-provided telephone interface module, normally located within two feet of the

meter. The phone line is referred to as a Single Business Line, Type 1FB, and should be ordered with NO additional features such as Call Waiting, Call Transfer, Call Hold, Message Waiting, etc., and no long distance service.

For network systems with IPBX or VoIP, an IP to analog (or gateway) device with modem pass through capabilities shall be installed by Customer and shall support analog modem service of 56kBps and higher. The IP to analog device shall also support CCITT V.90 and CCITT V.92 standards, and lower.

Customer is responsible for paying monthly fees for dedicated analog phone lines. In the event phone service is disrupted, Customer is responsible for resolving the issue.

Customer will be advised at time of application if APS has additional requirements for production metering and/or communication circuitry.

9.4 Third-Party Customer Metering

If Customer installs third-party metering equipment, Customer shall ensure that no wiring, or other Customer-owned equipment enters into any APS sealed compartment or enclosure. Customer-provided CT circuitry for DG systems required to measure loading installed inside the SES shall be split core. CTs and associated circuitry installed shall be in accordance with the NEC and manufacturers' instructions, and shall not violate the UL listing of the SES or other panelboards (if installed in different locations). Proof of such may be required by APS. **Customer-installed meters and associated equipment installed to measure Generator output shall be located on the Generator side of APS' Production Meter. Third party metering equipment must be clearly labeled to distinguish it from the APS Production Metering equipment.** Refer to the Example Equipment Tags located at www.aps.com/dg.

Any connections made on the Generator side of the Production Meter in order to accommodate third-party metering or monitoring equipment shall be of negligible load so as to not affect the GF output as measured on the Production Meter.

10 PROTECTION

10.1 Design Considerations and Definition of Classes

Protection requirements are influenced by the size and characteristics of the parallel generator along with the nature and operational characteristics of the associated APS System. Therefore, similar units connected to different lines could have different protection requirements based on varying load conditions, as well as on utility feeder and transformer characteristics.

(A) Synchronous Units

Synchronous generators are generally capable of supplying sustained current for faults on the APS System. These units can also supply isolated APS load providing the load is within the units' output capability.

Reclosing of the Utility power source onto synchronous units must be blocked to prevent out-of-sync paralleling and must also be prevented from energizing a de-energized utility line. Automatic reclosing by APS is time-delayed which allows for automatic Customer Generator separation prior to re-energization of the utility source.

(B) Induction Units

Induction generators are basically induction motors that are mechanically driven above synchronous speed to produce electric power. These units do not have a separate excitation system and, as such, require that their output terminals be energized with AC voltage and supplied with reactive power to develop the magnetic flux. Induction generators are therefore normally not capable of supplying sustained fault current into faults on the Utility System. Such units are generally not capable of supplying isolated load when separated from the Utility System; however, it is possible for an induction generator to become self-excited if a sufficient amount of capacitance exists at its output terminals.

Under conditions of self-excitation, an induction generator will be capable of supplying isolated load, providing the load is within the units' output capability. In most cases when self-excitation occurs, it will be accompanied by a sudden increase in terminal voltage. APS and its other Customers must be protected from out-of-phase closing and over-voltages that can occur whenever an induction generator becomes self-excited. Induction units must therefore be designed to automatically separate from the Utility System upon loss of utility voltage and prior to reclosing of the utility feeder.

(C) Static Inverters

Static inverters convert DC power to AC by means of electronic switching. Switching can be controlled by the AC voltage of the utility's supply system (line-commutated) or by internal electronic circuitry (forced-commutated).

Line-commutated inverters are generally not capable of operating independently of the utility's AC supply system, cannot normally supply any appreciable fault current, or continue to energize isolated loads provided proper protective functions are in place. To accommodate such protective functions, any line-commutated inverter that is electrically

paralleled with the APS System shall be tested and certified to UL 1741 Standard for Inverters, Converters and Controllers for use in Independent Power Systems, (including Supplements SA and SB* or subsequent UL equivalent supporting the latest IEEE 1547 standard), by a NRTL certified by OSHA to perform the test.

Forced-commutated, or self-commutated, inverters are capable of energizing load independently of the Utility System. Any forced-commutated inverter, the output of which is to be directly interconnected with the Utility, needs to be specifically designed for that purpose. It would need to be designed to accommodate parallel interfacing and operation. To accommodate such control functions, any forced-commutated inverter that is electrically paralleled with the APS System shall be tested and certified to UL 1741 Standard for Inverters, Converters and Controllers for use in Independent Power Systems, (including Supplements SA and SB* or subsequent UL equivalent supporting the latest IEEE 1547 standard), by a NRTL certified by OSHA to perform the test.

* Supplement SB certification requirement shall become effective July 1, 2023.

(D) Definition of Generator Size Classes

The following generator size classifications are used in determining specific minimum protective requirements for distributed GFs. Specified ratings are for each connection to the APS System. Customers must satisfy, in addition to the general requirements specified in this document, the minimum relaying requirements given in this document (Section 10.2) for each generator class.

Class I -- 50 kW or less, single or three phase

Class II -- 51 kW to 300 kW, three phase

Class III -- 301 kW to 5,000 kW, three phase

Class IV -- over 5,000 kW, three phase

10.2 Protective Relaying Requirements

(A) General Requirements

(1) Customer shall be solely responsible for properly protecting and electrically paralleling its generator(s) and/or static inverter(s) with the APS System.

(2) For Generators, Customer facility shall include an automatic interrupting device (normally the generator breaker) that is rated to interrupt available fault (short circuit) current and is tested and certified to applicable UL standards. The interrupting device shall be directly tripped (and not via a programmable logic controller, etc.), as a minimum, by all protective devices required herein. If a Local/Remote control selector switch or any other component is wired in series with the trip and/or close circuit, said component(s) shall not impede or bypass any of the protective devices required herein, or the ability to trip/close the automatic interrupting device. Breakers downstream of the main shall have adequate overcurrent protection (i.e., 50, 51, 50N and 51N).

(3) Inherent characteristics of induction disk type voltage and frequency relays render their use unsuitable for some generator interface protection applications.

Therefore, relays with definite level and timing characteristics (e.g., solid state type relays) will be necessary to meet the minimum requirements established herein.

(4) For Rotating Generator classes II and greater (> 50 kW) that utilizes discrete relays, separate and independent voltage and frequency relays and associated trip paths to the automatic interrupting device are required. This is to ensure a redundant trip function in the event of a single relay failure or out-of-tolerance condition.

It is acceptable however, for the over/under voltage functions to be integrated into a single o/u voltage relay, and for the over/under frequency functions to be integral to a single o/u frequency relay.

As an option, the frequency and voltage functions may be incorporated into a single microprocessor-based protective relay provided that the relay incorporates relay failure alarm contacts, and such output is wired to trip the automatic interrupting device upon (1) relay failure or (2) loss of power to the relay. In lieu of tripping the automatic interrupting device, and with APS approval, Customer may configure the relay to alert a 24-hour Operations Center for a relay failure condition.

(5) For Rotating Generator protective schemes that utilize microprocessor based, multi-function relays, the protective relay failure alarm contacts will be configured to trip the automatic interrupting device. This requirement shall also apply to any GF utilizing static inverters with an aggregate AC output nominal nameplate rating of 1000 kW and greater.

(6) The protective scheme referenced in Section 10.1(A)(5) above shall be of a fail-safe design such that loss of the protection scheme control power will (immediately) cause the automatic interrupting device to open. Additionally, control power to the relay shall be fed via a dedicated hard-wired UPS circuit.

(7) With the addition of generation at a Customer site, ground fault current magnitude might increase to a level where the existing grounding grid is insufficient to protect personnel from step or touch potentials. Customer shall ensure the adequacy of the facility grounding grid to keep any step and touch potentials at a safe level.

(8) Customer shall ensure that the GF protective relaying and controls are adequately protected from electrical surges that may result from lightning, utility switching or electrical faults.

(9) A Rotating Generator utilizing a Momentary Parallel Transition transfer scheme shall install an independent backup timer that directly trips the main breaker(s) feeding the SES. The trip circuit shall not be routed through any circuits or logic scheme that could inhibit or block the trip signal, and not via a PLC, etc. Refer to Section 13.2 for additional details.

(10) The GF shall provide voltage regulating capabilities at the POI unless otherwise determined by APS. APS will advise Customer of specific settings as noted in Section 10.1(A)(13) and Section 12 of this document (e.g., power factor, reactive power and/or automatic voltage regulation) and any associated set point(s) during the Interconnection Application process. Customer will be fully responsible for implementing any identified recommendations.

(11) APS reserves the right to require curtailment of GF real power output in the event APS System issue occurs in an abnormal or unplanned event. Curtailment can be accomplished via utility grade metering, plant control equipment, operating the Utility Disconnect and/or the individual inverter level (for Static Inverter based GF) as determined by APS. In addition, remote operable curtailment required at APS' option.

(12) For GF comprising static inverters installed to address an APS System issue as a non-wires solution shall install microprocessor backup relaying such as a SEL 351-7 or equivalent (i.e., intertie relay) with functions/features and parameters determined by APS Study in accordance with this manual and/or any state, local and/or national standards (for example, latest IEEE 1547). The microprocessor relay shall trip the GF over-current device(s) for any out of tolerance conditions. Additional communication and control circuitry/capability may be required. Reference Section 11 for additional details. In addition, provisions for power quality metering along with appropriate isolation (i.e., visible open disconnecting means) as required for troubleshooting and maintenance will be required.

NOTE: APS may opt to apply this requirement for GF comprising static inverters with an aggregate AC output nominal nameplate rating less than 250 kW in the event the interconnection occurs on a stressed utility feeder.

(13) Any GF comprising static inverters with an aggregate generator AC output nominal nameplate rating of 10 MW or less, and interconnecting with a Dedicated Utility Feeder, shall utilize inverters that have been tested and certified as specified in Section 12(A), or Customer shall ensure, at a minimum, that the inverter performance tests specified below are performed and certified by a NRTL to ensure compliance with the following Sections of latest IEEE 1547 (per Section 40.1 of UL 1741):

IEEE 1547.1 Section 7 Power Quality

a. Section 7.1 Limitation of DC injection
b. Section 7.2 Limitation of voltage fluctuations induced by the DER
c. Section 7.3 Limitation of current distortion
d. Section 7.4 Limitation of overvoltage contribution

Customer shall provide APS with a copy of the test results and certification from the NRTL, for APS review and approval.

(14) Any GF comprising static inverters with an aggregate generator AC output nominal nameplate rating of greater than 10 MW and interconnecting with a Dedicated Utility Feeder, shall be equipped to support the options specified per Section 12. However, Customer shall ensure, at a minimum, that the inverter performance tests specified below are certified by a NRTL to ensure compliance with the following Sections of latest IEEE 1547 (per Section 40.1 of UL 1741):

IEEE 1547.1 Section 7 Power Quality

a. Section 7.1 Limitation of DC injection
b. Section 7.2 Limitation of voltage fluctuations induced by the DER

c. Section 7.3 Limitation of current distortion

d. Section 7.4 Limitation of overvoltage contribution

Customer shall provide APS with a copy of the test results and certification from the NRTL, for APS review and approval.

(B) Minimum Relaying Requirements

(1) Class I (Single or Three Phase: 50 kW or less)

a. For this class of installation, utility grade protection devices and equipment are required.

b. The minimum protection required for induction and synchronous generators is an under-voltage relay.

c. Synchronous generators require a synchronizing scheme, either manual with a synch check relay, or an automatic synchronizer.

(2) Class II (Three Phase: 51-300 KW)

a. For this class of installation, utility grade protection devices and equipment are required.

b. The minimum protection required for induction and synchronous generators is under-voltage, over-voltage, under-frequency, and over-frequency.

c. Synchronous generators require a synchronizing scheme, either manual with a synch check relay, or an automatic synchronizer.

d. A redundant over/under voltage and over/under frequency relay (single microprocessor-based relay) may be required for static inverters with an AC output nominal nameplate rating of ≥250 kW, or whenever the aggregate inverter AC output nominal nameplate rating of a GF ≥250 kW.

e. For installations interconnected to the Utility through a transformer with connections that will not supply current to a ground fault on the Utility System, a ground fault detector may be necessary. APS will advise Customer of any such requirements after a preliminary review of Customer's proposed installation.

f. Other equipment such as supervisory control and alarms, telemetering and associated communications channel may be necessary. This is especially the case when the generator, or an aggregate of generators, is large relative to the minimum load on a feeder or sectionalized portion thereof. APS will advise Customer of any communications requirements after a preliminary review of the proposed installation. Refer to Section 11 for more details.

(3) Class III (Three Phase: 301-5,000 kW)

a. For this class of installation, utility grade protection devices and equipment are required.

b. The minimum protection required for induction and synchronous generators is under-voltage, over-voltage, under-frequency, over-frequency, and negative sequence time overcurrent.

c. Synchronous generators require a synchronizing scheme, either manual with synch check relay, or an automatic synchronizer.

d. A redundant over/under voltage and over/under frequency relay (single microprocessor based relay) may be required for static inverters with an AC output nominal nameplate rating of ≥250 kW, or whenever the aggregate inverter AC output nominal nameplate rating of a GF ≥250 kW.

e. For installations interconnected to the Utility through a transformer with connections that will not supply current to a ground fault on the Utility System, a ground fault detector may be necessary. The Utility will advise Customer of any such requirements after a preliminary review of Customer's proposed installation.

f. Other equipment such as supervisory control and alarms, telemetering, and associated communications channel may be necessary. APS will advise Customer of any requirements after a preliminary review of the proposed installation. Refer to Section 11 for details.

(4) Class IV (Three Phase: Greater than 5,000 kW)

NOTE: Induction Generators or Line Commutated Inverters in this size range are not anticipated.

a. For this class of installation, utility grade protective devices and equipment are required.

b. Relays for under-voltage, over-voltage, under-frequency, and over-frequency are required.

c. Synchronous generators require a synchronizing scheme, either manual with synch check relay, or an automatic synchronizer.

d. A ground time overcurrent and ground instantaneous overcurrent relay, or for installations interconnected to the Utility through a transformer with connections that will not supply current to a ground fault on the Utility System, a ground fault detection scheme is required. APS will advise Customer of any such requirements after a preliminary review of Customer's proposed installation.

e. The following protective functions are also required:

   i. Voltage-controlled time overcurrent

   ii. Loss of excitation

   iii. Over-excitation

   iv. Negative sequence time overcurrent

f. Other equipment such as supervisory control and alarms, telemetering, and associated communications channel are generally required. APS will advise Customer of any such requirements after a preliminary review of the proposed installation. Refer to Section 11 for further details.

The minimum protective relaying requirements for parallel operation of distributed generation are summarized in the table below. An exception to the relaying requirements on the

following table may be made for Momentary Parallel Transition systems – refer to Section 13.2 for applicable requirements.

Note that depending on the specific application of the GF, a Reverse Power relay may be required. APS will advise Customer of any such requirement after a preliminary review of the proposed installation.

Table 10.2 *Summary of Minimum Protective Relaying Requirements*

	Induction Generator	Synchronous Generator	Static Inverter
Class I 50 kW or less	Undervoltage	Undervoltage, Synchronizing	*UL 1741, and *IEEE 1547
Class II 51 to 300 kW	Overvoltage, Undervoltage Overfrequency, Underfrequency	Overvoltage Undervoltage, Overfrequency, Underfrequency Synchronizing	*UL 1741 and IEEE 1547
Class III 301 to 5,000 kW	Overvoltage, Undervoltage Overfrequency, Underfrequency Negative Sequence Time Overcurrent	Overvoltage, Undervoltage, Overfrequency, Underfrequency Synchronizing Negative Sequence Time Overcurrent	*UL 1741 and IEEE 1547 ** Refer to Sections 10.1(A), 11, and 12 for additional GF aggregate requirements.
Class IV Greater than 5,000 kW	No induction generators of this size anticipated	Overvoltage, Undervoltage, Overfrequency, Underfrequency, Synchronizing, Ground Time Overcurrent, Ground Instantaneous Overcurrent, Voltage-controlled Time Overcurrent, Loss of Excitation, Overexcitation, Negative Sequence Time Overcurrent	*UL 1741 and IEEE 1547 ** Refer to Sections 10.1(A), 11, and 12 for additional GF aggregate requirements.

*Inverters shall be tested and certified to UL 1741 Standard for Inverters, Converters and Controllers for use in Independent Power Systems, (including Supplements SA and SB or subsequent UL equivalent supporting the latest IEEE 1547 standard), by a NRTL certified by OSHA to perform the test. Supplement SB certification requirement shall become effective July 1, 2023.

Redundant O/U voltage and O/U frequency protection may be required for individual inverters with an AC output nominal rating of ≥250 kW, or whenever the aggregate inverter AC output nominal nameplate rating of a GF is ≥250 kW. Such protection shall be applied to one or more breakers external to the inverter(s).

**For utility scale installations utilizing static inverters with an aggregate AC output nominal nameplate rating of ≥10 MW a redundant O/U voltage and O/U frequency protection will be required. Such protection shall be applied to one or more breakers external to the inverter(s) (i.e., the main GF breaker(s)).

(C) Relay Settings

(1) NOTE: Voltage and frequency relays needed for minimum interface protection for all classes will have setting limits as specified below. Under-voltage relays will operate at no less than 80% of the nominal voltage level and will have a maximum time delay of 1.0 seconds.

(2) Over-voltage relays will operate with a maximum time delay of 1.0 seconds for a voltage range of higher than 110% and less than 120% of nominal voltage. The relay will operate instantaneously at 120% or higher of nominal voltage to provide a maximum clearing time of 10 cycles.

(3) Under-frequency relays will operate at no less than 58 Hz and have a maximum time delay of 1.0 seconds.

(4) Over-frequency relays will operate in 6 cycles above 60.5 Hz. Maximum clearing time of the breaker will be 10 cycles.

(5) Additional settings for Class I, II, III & IV installations and/or any other relays that may be required due to unusual circumstances will be handled on an individual basis.

11 ADDITIONAL REQUIREMENTS FOR GF ≥ ONE (1) MW

This Section covers additional requirements that apply to any one GF or aggregate of GFs with a combined AC output nominal nameplate rating of 1 MW or greater, interconnected with the APS System for Continuous Parallel operation.

The 1 MW threshold applies to one or more Generators (a) connected to any single APS metered point of electric service delivery or (b) connected to multiple metered points of electric service delivery connected to a single APS System Source Device.

A GF with an aggregate generator AC output nominal nameplate rating of less than 1 MW will not typically need to incorporate the requirements specified in this Section. However, depending on the GF's impact to the APS System, APS may require the GF to incorporate one or more of the requirements outlined in this Section.

APS will identify the actual requirements, and the optimum method of implementation, normally as part of the Interconnection Study (refer to Section 16.7). APS can also assist Customer in addressing any design requirements prior to submitting an application and drawings for review.

Modifying GF AC system output (kW) that does not involve the modification of any installed equipment such as controller programing, setting field or software modification that was in place to limit power (i.e., power limiting) will require notification to APS, and may require secondary nameplate/placards be installed to alert the Customer, their contractors and APS personnel working on the equipment in the future.

11.1 Transfer Trip

Transfer trip requirement will be evaluated based on the result of an interconnection study and agreed upon the Customer and APS.

(A) A Transfer Trip scheme will normally comprise a relay located at the APS substation feeder breaker that communicates via fiber optic cable with a relay located at the GF along with associated control circuits. Whenever the APS substation breaker opens, a trip signal is sent to the GF to automatically trip the generation off line.

(B) If GF is fed from a Dedicated Utility Feeder, and it is determined during the interconnection review process that a transfer trip scheme is needed, APS will require Customer to install a relay and communication link that interfaces with the APS substation relay. In the event that a transfer trip is required, Customer will need to install and maintain a Schweitzer SEL 351-7 relay for transfer trip control of the Generator breaker along with the associated instrumentation transformers and circuitry. APS will install, at Customer's expense, a SEL 351-7 relay at the APS substation.

(C) In accordance with the APS ESRM, APS will provide Customer with the overcurrent relay settings (50, 50N, 51, and 51N) for the SEL 351-7 relay located at the GF for coordination with the SEL 351-7 relay at the APS substation. Customer will activate device functions 27 (Undervoltage), 59 (Overvoltage), and 81 O/U (Over/Under Frequency) in the SEL 351-7 relay located at the GF with trip set points in accordance with Section 8.7(C) of this document. Customer shall incorporate a relay failure alarm in accordance with 8.7(A)(5) of this document. Customer will submit settings for APS review and approval.

(D) In the event that there is a loss of Mirrored Bits communication between the APS Substation relay(s) and GF relay(s), the GF breaker(s) shall trip open via the GF relay(s) settings. It is acceptable to add a 15 cycle delay for loss of Mirrored Bits within the GF relay(s) settings to avoid nuisance trips.

11.2 Remote Trip

(A) A Remote Trip is a manual trip signal issued by the APS Control Center to trip the generation offline and isolate it from the APS Distribution System. This signal will normally be communicated via fiber optic cable originating at the APS substation or by a radio frequency via an antenna. It will generally trip the generator breaker(s) via a Customer installed breaker control circuit.

(B) A GF with an aggregate generator AC output nominal nameplate rating less than 1 MW will not typically require remote trip capability specified. However, depending upon the GF's impact on the APS System, APS may require remote trip and remote monitoring capability.

(C) The Remote Trip function will be accomplished via a Remote Terminal Unit (RTU) provided by APS at Customer's expense and the cabinet and connections will be installed by Customer at Customer's Facility.

(D) For a GF comprising static inverters located on a non-Dedicated Utility Feeder, should APS need to switch the section of the normal feeder on which the GF is located to another feeder for line/breaker maintenance, feeder sectionalizing/switching, and/or load transfer operations, APS reserves the right, without liability, to remotely trip the GF off-line for the duration of any such operation.

(E) If adverse operating conditions occur on the APS System due to the GF, APS reserves the right to open the Generator breaker without notice until such conditions are addressed. Customer will assume full responsibility for the inverters shutting down in accordance with UL 1741 in the event of a utility outage or system fault.

(F) For a GF located behind a primary meter on a Dedicated Utility Feeder, an exception to the remote trip requirements may be granted by the Energy Delivery Compliance Committee (EDCC). APS Planning, Operations and Interconnection Engineering shall mutually agree to submit the exception request to EDCC prior to the request submittal. Remote monitoring or GF production data in 15 minute intervals may still be required.

11.3 Remote Monitoring

(A) The GF shall be equipped for remote monitoring by the APS Control Center. APS will install, at Customer's expense, an EMS Meter (in addition to the billing meter) along with communication wiring in the SES incoming metering section to provide instantaneous Watts, kVA, vars, Volts, Power Factor, Amps and cumulative kWh readings to the RTU.

(B) For all installations, Customer must provide two meter sockets and two sets of test switches at the SES metering compartment in accordance with the APS ESRM – one set for the EMS Meter and the other for the billing meter. APS may elect to temporarily install, and at APS's expense, transducers in place of the EMS Meter, in the event this meter is not available at the time of the GF start-up. Once the EMS meter becomes available, APS will coordinate with Customer to install it and remove the transducers.

(C) For Behind the Meter/R-DER applications, in addition to metering located at the SES as required per Section 11.3(A) above, a meter is required to be installed to monitor the Generator output. Customer will provide a metering section in accordance with the APS ESRM. APS will install, at Customer's expense, an EMS meter along with communication wiring in the metering section to provide instantaneous Watts, vars, Volts and cumulative kWh readings to the RTU.

(D) Customer will provide hard-wired open/close contact (b contact) status points and control wiring to the RTU for any breaker with Remote Control capability by APS so that APS can monitor the status of this breaker remotely.

11.4 Technical Details

(A) At Customer's expense, APS will provide, operate and maintain an RTU. Customer shall install the RTU enclosure as provided by APS, and APS will install and program the RTU. Customer shall provide a 120 VAC, 15 Amp (minimum) power supply to the RTU, and shall install 2" rigid metallic conduits for all required circuits associated with the RTU. The 120VAC/15A circuit must be from a dedicated feed upstream from the Generator breaker, so it remains energized in the event the Generator breaker is open. The RTU and associated equipment installed at the GF must be located at a Readily Accessible location (available 24 hours) for APS personnel. For all PPA/Customer Owned GF, the dedicated 120 VAC circuit shall not be backed up via Customer provided UPS.

(B) The RTU will be housed in an enclosure along with an appropriate communication device (e.g., fiber converter, or modem as specified by APS), and battery backup system. The RTU enclosure typically measures 36"X30"X10", and is a NEMA 3R outdoor rated cabinet. Additional RTUs may be required if a single RTU cannot be located in the immediate vicinity of the SES and any required metering on the generation output. The top of the RTU cabinet shall not exceed more than 6' from final grade.

(C) Customer is responsible for securing a communication path back to the APS communication system (e.g., fiber optic back to APS Substation). In the event the communication path is disrupted for any reason, Customer is responsible for remedying the issue.

In some instances, APS may provide a communication path back to the APS communication system via a MAS radio. Customer will be responsible for all associated costs, and shall also provide a location to install antennas tall enough to provide line of sight from the MAS radio antenna to APS communication towers in the area.

(D) In the case the communication system located at the APS Substation (or designated APS location) communicating back to the APS EMS system cannot support the additional data points, Customer will be responsible for upgrading the communication path. The cost of any communication upgrades, and the monthly service fee will be passed on to Customer.

(E) Equipment and means of completing the communication path will be determined by APS and communicated to Customer during the Interconnection Study process (refer to Section 16.7).

(F) Customer will provide, install and maintain Generator breaker control circuitry ("Breaker Control Scheme") that will accept two remotely initiated control functions from the APS EMS system through the APS RTU (for each generation breaker). If a Local/Remote

control selector switch or any other component is installed and wired in series with the trip and/or close circuit associated with the Generator Breaker, the APS remote trip & block close/close permissive control circuit must not be impeded. APS must be able to remotely trip the Generator breaker open regardless of the position of the Local/Remote control switch.

(1) Trip Function: Contacts will close momentarily when APS issues a trip command through the RTU.

The trip function contacts within the APS RTU are "dry" (not powered by APS). Maximum ratings for the contacts on the trip relay in the APS RTU are as follows:

- 10A, 120VAC
- 3A, 125 VDC
- 10A, 28VDC

(2) Remote Close Function: Contacts will close momentarily when APS issues a remote close command through the RTU.

The close function contacts within the APS RTU are "dry" (not powered by APS). Maximum ratings for the contacts on the trip relay in the APS RTU are as follows:

- 10A, 120VAC
- 3A, 125 VDC
- 10A, 28VDC

NOTE: Remote Close Function is only required for APS Owned projects with an RTU. Customer may opt to install a separate remote close scheme for Customer owned GFs.

(3) Close Permissive/ Block Close Function: Contacts will latch in the closed position when APS enables a close permissive command. Contacts will latch in the open position when APS disables the close permissive, i.e., issues a block close.

The generator breaker control logic will allow Customer to operate associated breaker. However, it will be necessary for APS to enable the close permissive first, allowing Customer to close the breaker.

NOTE: The only acceptable means by which the GF breaker(s) is permitted to be closed shall be via the breaker control circuitry (locally or remotely). Circumventing the breaker control circuitry by manually closing the GF breaker(s) for purposes of energizing the GF is not allowed by APS. Customer shall disable manual closure of the GF breaker(s) by installing a mechanical blocking accessory (i.e., close defeat cover plate) or other means acceptable to APS.

The close permissive function contacts within the APS RTU are "dry" (not powered by APS). Maximum ratings for the contacts on the close permissive relay in the APS RTU are as follows:

- 10A, 120VAC
- 0.5A, 125 VDC

- 10A, 28VDC

Customer is responsible for providing an interposing relay and any associated power source if needed to ensure that the APS RTU contact ratings are not exceeded.

Depending on the GF system configuration, these functions may be applied to either individual Generator breaker within Customer gear or to a single main Generator breaker for the GF in order to isolate the Generator(s) from the APS System.

NOTE: APS will provide a "wetting" voltage of 24 VDC for Customer generation breaker status contacts. APS will require an AC/DC schematic diagram for the Breaker Control Scheme as part of interconnection diagram submittal showing terminal connections and sequence of operations of the trip and close permissive/block close functions.

(G) APS can provide upon request Sample Diagrams showing typical RTU/Communication requirements. These requirements must be incorporated on the final Electrical One-Line Diagram required for APS interconnection review.

(H) Customer shall include an Uninterruptable Power Supply (UPS) or battery bank with a DC to AC inverter for any required Breaker Control Scheme and any SEL 351-7 relay to be operational if the normal power source should fail. The UPS shall be capable of supplying backup power for at least six continuous hours and shall be hard-wired (a "plug in" UPS is not acceptable).

(I) Customer will perform periodic maintenance on the UPS batteries to ensure that it remains in operational condition at all times. Documentation that the UPS has been tested and is operational as part of the APS final inspection.

11.5 Project Details

(A) Circuit requirements are dependent on generation size and all system additions and system improvements to meet the needs of Customer for its DG installation. Any additions/improvements to the APS System as a result of the DG installation will be expensed to Customer. A cost summary will be provided to Customer as part of the Interconnection Study (refer to Section 16.7).

(B) The materials required for the RTU and specialized metering are long lead time items taking as long as 4 months to receive. APS cannot allow Customer to place the GF on-line until after all APS and Customer required work outlined in the Interconnection Study (refer to Section 16.7) has been completed and all applicable requirements being implemented as delineated in APS Interconnection Requirements.

(C) Customer is advised to communicate need dates to APS as soon as practically possible so as to avoid project delays.

(D) A communication shelter may be required (specifically for APS owned projects) to house the Supervisory Control and Data Acquisition (SCADA), communication, and any security equipment. At Customer's option, a second service can be provided at the applicable retail rate and system voltage for the communication shelter electrical service. In such cases, APS will coordinate the RTU and associated communication equipment arrangement and installation details with Customer.

(E) The communication shelter will be provided and installed by Customer. Customer shall provide and install instrumentation racks inside the communication shelter. Racks shall be properly grounded utilizing #4/0 copper wire. A GPS clock shall also be provided and installed by Customer (i.e., Arbiter Systems 1094B GPS Substation Clock). Customer shall provide time synch from the GPS clock to the protective relays installed at the medium voltage switchgear.

(F) If a communication shelter is required APS suggests ample time be allotted for ordering, delivering, and installation of the communication shelter and associated equipment. All conduits, wiring, and components related to the SCADA, communication, and any security system shall be installed prior to final commissioning. APS will provide additional details during the construction phase.

(G) Any proposed generation 1 MW and greater will normally require an APS System Impact Study (SIS) to determine the impact to the APS System. Please refer to Section 16.7 of the APS Interconnection Requirements for additional details. Depending on the results of the SIS, APS may require a Dedicated Utility Feeder. The following are potential triggers used to determine the need for a Dedicated Utility Feeder, which will be required for all U-DER applications:

(1) A GF greater than ½ of a typical APS distribution feeder rating.

(2) In Metro, the typical distribution feeder rating is 13 MW/MVA, but the rating could be less in State Region depending on the area.

(3) A Rotating Machine (i.e., synchronous generator) normally 1MW and greater.

(4) If it is determined that the DG penetration limits of the distribution feeder will be exceeded.

(5) The aggregated generation (including the GF) shall not exceed 50% of the distribution feeder's continuous rating.

(6) The Customer is expected to pay the cost for designing, installing and maintaining the installation of a Dedicated Utility Feeder interconnecting to the APS System.

12 ADVANCED GRID SUPPORT FEATURES

The requirements outlined in this Section apply to any GF interconnected with the APS System and configured for Parallel Operation. These requirements are in addition to those specified in Sections 8, 10 and 11 of this document. Any GF may require an Interconnection Study per Section 16.7 of this document. Additional requirements will be identified in the Interconnection Study or as otherwise determined by APS.

NOTE: Appropriate system sizing and inverter selection may reduce potential curtailment of real power output when operating the GF at other than unity power factor. APS strongly recommends that Customer take this into consideration during the GF design. Appropriate Generator nameplate capacity may need to be installed at the GF to achieve a specified real power output when operating in the control modes specified below (i.e., appropriate MW/MVA ratio sizing to support operation at ± 0.9 or ±0.95 power factor refer to section 12.4 for requirement).

12.1 Reactive Power Capability, Voltage Regulation Performance and Abnormal Response

(A) GF < 10MW

APS requires all inverters to be tested and certified to UL 1741 (See Section 10.1(C)). All inverters shall meet minimum operating capabilities in compliance with DER normal operating performance Category B and abnormal operating performance Category III per the latest IEEE 1547 standard. APS will provide standard default settings. An APS Interconnection Study may determine settings other than the default settings are required. If the GF cannot perform the functions in the provided settings, the modified settings, the programming, set points, and specific settings will be agreed upon between the Customer and APS.

(B) GF ≥ 10 MW

Any GF, that parallels with the APS System with an aggregate generator AC output nominal nameplate rating of 10 MW and greater, shall be capable of meeting all of the operational/control modes specified below. As part of the Interconnection Study, APS will specify whether these operational/control modes shall be measured at the inverters, SES or POI. This point is known as the “Point of Measurement” (POM).

(1) Capability to operate in PFC mode at a fixed power factor as agreed upon bewteen the Customer and APS within the range of at least plus or minus 0.95 power factor at any power output level up to the maximum rated MW output of the GF. If the POM is different from the POI, it may be necessary to have a wider range of power factor set points in order to deliver enough reactive power to the POI. Power Factor Control mode is defined as a site varying its reactive power output to achieve a constant power factor output. PFC may be unstable at very low loads. GFs may revert to unity power factor operation when operating below 10% of nameplate MW capacity. Battery Storage based GFs should be able to operate in Power Factor Control mode whenever importing or exporting more than 10% of nameplate MW capacity.

(2) Customer shall set the GF to operate at the APS default setting of PFC with a 0.98 leading setpoint unless a different set point or operating mode is specified by APS.

Leading from APS perspective means: absorbing reactive power (bucking) into the GF when exporting real power, and exporting reactive power (boosting) out of the GF when importing real power. It is acceptable for Customer to achieve this default setting at the Generator output terminals.

(3) The reactive power level calculated at 0.95 power factor (either lagging or leading) with the GF producing full rated real power output represents the required reactive power capability of the GF. The GF must be capable of delivering or absorbing this amount of reactive power at the POI in any of the active control modes specified in this Section.

(4) Capability to operate at any fixed reactive power (Mvar) output at any power level within the full reactive power range calculated in 12.1(B)(3) above while the GF is producing power. Battery Storage GFs should be able to operate at any fixed reactive power output level within the range calculated in 12.1(B)(3) while the inverters are connected to the grid.

(5) Capability to operate in AVR mode to regulate the voltage to a selected nominal voltage range of 0.95p.u. to 1.05p.u. at the POM, to the extent that such voltage regulation can be achieved with the available reactive power calculated in Section 12.1(A)(1).

(6) Voltage regulation shall be within 0.005p.u. of the voltage set point.

(7) From time to time, APS will specify whether Customer will operate the GF in PFC, Mvar or AVR mode. APS will specify the associated set point. Such specification may be based upon the results of the Interconnection Study and/or changes to, or conditions arising on, the APS System.

(8) Capability to operate in a standard Volt-Var mode.

12.2 Plant Controller and System Performance Requirements:

(A) A GF that incorporates a suitable controller (e.g., “Power Plant Controller” or “Dynamic Reactive Device”) shall be capable of operating/controlling the GF in all of the modes specified in 12.1(B).

(B) Performance requirements: Upon the controller receiving a step change in a reference point value, the plant controller shall begin to respond within 500 ms (refer to $\mathbf{t_1}$ and $\mathbf{t_2}$ on Figure 1). The controller shall drive the plant output to 90% of the new reference point value within 4 seconds of receiving the step input (refer to $\mathbf{t_3}$ on Figure 1), and shall settle/damp out to a final value within 8 seconds of step input irrespective of operating mode (refer to $\mathbf{t_4}$ on Figure 1). Overshoot in any mode shall not exceed 5% of aggregate rated reactive power for the site.

(C) Customer shall provide written control system specifications that include an executive summary detailing the operation of the control system. The control system operation and specifications shall comply with all applicable APS requirements and shall include, but not limited to, the bill of materials, control system block and single line diagram(s), and anticipated performance parameters. The customer shall submit the control system specifications and executive summary to APS for review and acceptance.

(D) Customer shall provide a written performance testing procedure as part of the drawing and application submittal. A sample procedure and/or checklist may be provided by APS.

(E) Once the GF is energized at full output, Customer shall be ready to complete performance testing of the GF within ten (10) business days. Customer will contact APS to coordinate scheduling of the performance testing on mutually agreed upon date(s). In the event APS personnel are not available to witness any/all performance testing, Customer shall provide a certified test report and supplemental information that demonstrates conformance to APS requirements noted herein for APS's review and acceptance.

A supplemental document outlining Dynamic Voltage/VAR Response Testing Procedures is available at: www.aps.com/dg.

(F) In the event of a control system failure, (e.g., loss of communication) the GF shall be configured to revert to the default setting as specified in Section 12. APS must be notified as soon as possible in the event of a control system failure, but no later than the following business day.

The control system shall be designed to allow its performance to be evaluated in all three of the operating control modes specified above by inputting a reference step change into the controller. In the case of the AVR mode, the step change shall constitute a change to the plant's desired output voltage set point. Figure 1 below depicts the typical response of a plant control system to a step change at time t_1. The time t_3 to reach 90% of the final output value is noted on the plot as well. After the output has attained 90% of its final value, there may be some overshoot and oscillatory response until the plant output settles out to its final value at t_4. There will be a small difference between the final value and the desired value specified by the set point. This difference is expressed as a percent error band referenced to the desired set point versus the actual final value.

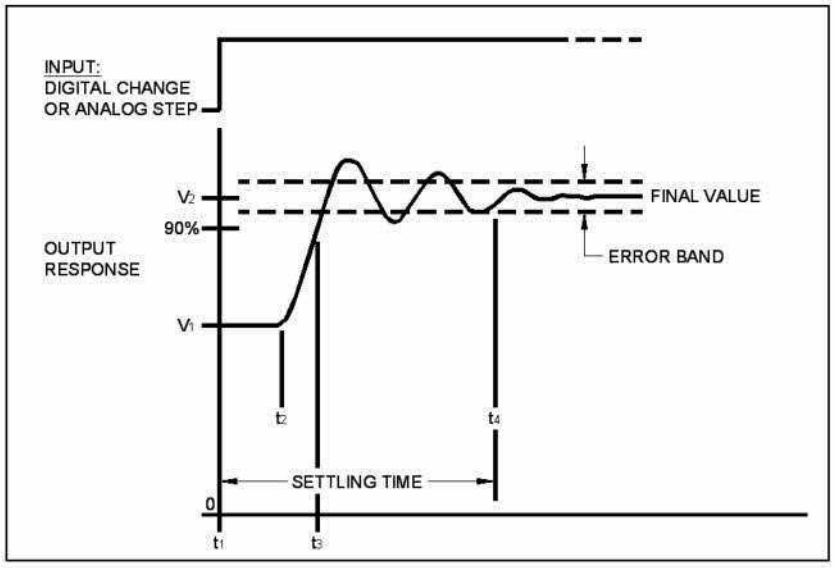

Figure 1 – Generalized Plant Response to a Reference Step Input Change

(G) If APS contacts Customer to change the operating mode or set point, Customer will implement request within four (4) hours if request is made between the hours of 6:00 am to 4:00 pm. If request is made outside these hours, request must be implemented by

8:00 am the following morning. Any such request will be made by the APS Energy Control Center (ECC).

12.3 Latest NERC Standard PRC-024 Frequency and Voltage Ride-Through Requirements

The requirements outlined in NERC Standard PRC-024 (Standard) apply to any GF interconnected to the APS System. Although this standard does not directly apply to distribution-based GFs, we are choosing to apply it to these facilities to increase overall reliability of the power system. APS may grant an exception to a GF interconnected to a non-dedicated distribution feeder, if ride-through will interfere with other APS protection, or if there are concerns with unintentional islanding. As a system, the entire GF must ride through the disturbances described in this Standard. This includes but is not limited to relay settings, Static Inverter ride-through settings, and, in the case of synchronous generators, the excitation system settings. This requirement also applies to grid monitoring settings in an inverter that result in Momentary Cessation of active current injection.

GFs subject to this Standard shall submit documentation depicting individual systems' Frequency Capability Curves, Trip Times, Voltage Ride-Through Time Duration Curves and any other information explaining how the GF meets the Standard. Customer shall provide an overlay of voltage and frequency ride-through capability for the site superimposed on top of the PRC-024 Standard curves. For frequency, the WECC values specified in this Standard shall be used.

All settings must be outside of PRC-024's "No Trip" zone. The developer must take into account the accuracy of the frequency calculation internal to the equipment when considering near instantaneous frequency protection. Frequency trip settings shall not be set shorter than 100 ms.

While all settings must comply with PRC-024, voltage and frequency trip settings should not be based solely on these curves. These settings should account for physical equipment limitations to protect the GF and distribution system. For all GFs, it is important to adequately evaluate voltage protection settings according to attachment 2 of PRC-024 to ensure that voltage protection settings at the GFs' terminals comply with the standard for voltage deviations at the POI.

Static Inverter based GFs are expected to continue current injection throughout the entire PRC-024 "No Trip Zone" for frequency and voltage. If "Momentary Cessation" in this zone is unavoidable due to hardware limitations, "Momentary Cessation" settings should be adjusted to allow the site to continue current injection for as much of the "No Trip Zone" as possible.

Any Static Inverter that enters a "Momentary Cessation" mode due to a grid voltage or frequency excursion shall be set to reconnect to the grid as quickly as possible once grid conditions return to normal. Ramp rate for the site upon return from momentary cessation should be set to 100% per second unless APS specifies a slower ramp rate based on an Interconnection Study.

Additional guidance on "Momentary Cessation" can be found in Chapter 1 of the NERC "BPS-Connected Inverter-Based Resource Performance Reliability Guideline," September 2018.

12.4 Power Factor

At a minimum all GFs paralleling with the APS grid shall have power factor capabilities per Table 12.4.

Table 12.4 *GF Minimum Power Factor Requirements*

Technology	Location for PF requirement	Minimum PF capability	Maximum PF capability
Inverter < 10MW	At the terminals of the inverter	Abs/Inj[1] 0.90	Nameplate[2]
Inverter ≥ 10 MW	At the POI	Abs/Inj[1] 0.95	Nameplate[2]
Synchronous machine	At the terminals	Abs/Inj[1] 0.95	Nameplate[2]

[1] The term absorbing vars, or Abs., refers to vars flowing towards the GF. The term injecting vars, or Inj., refers to vars flowing away from the GF.
[2] Full nameplate capability for var support is based on Customer and APS agreement

13 SOURCE TRANSFER EQUIPMENT

The requirements outlined in this Section apply to a Customer facility utilizing Source Transfer Equipment to transfer all or part of the facility electrical load between two or more power sources – typically one source being the Utility and the other being a Backup Generator. This Section provides supplemental information to that outlined in Sections 4 and 8 of this document.

Typically, Source Transfer Equipment consists of either a transfer switch listed to UL 1008/1008A, or a true double throw switch listed to UL 98. This equipment meets APS Open Transition requirements; therefore, customer is not required to install a Utility Disconnect.

Other types of Source Transfer Equipment may be comprised of custom-built transfer schemes, such as Kirk-key interlocks, two main transfers, main-tie-mains, etc. These are not listed to UL 1008/1008A and are considered by APS to be a potential Backfeed source. Therefore, customer will be required to install a Utility Disconnect and submit drawings showing the interlock logic for APS review and approval.

While either a Transfer Switch or Transfer Scheme may be used to transfer Customer load between a utility source and a Backup Generator, a Transfer Scheme must be used when transferring from one utility source to another utility source, for instance when a Customer SES is fed via two utility services. While Backup Generators are designed to primarily operate in a stand-alone mode (electrically isolated from the utility source) in order to power emergency load, they may be designed to electrically parallel with the Utility for short periods (< 15 seconds) in order to effect a power transition between power sources.

All Source Transfer Equipment shall have adequate interrupt ratings and fault withstand capabilities in accordance with paragraphs 1910.303(b)(4) and 1910.303(b)(5) of OSHA Rules and Regulations as well as NEC Articles 110.9 and 110.10.

The connection with, and the operating modes of, Source Transfer Equipment connected to the APS System is subject to APS review and acceptance as is described below. APS may request additional details following APS receipt of a Customer Application and associated Supplementary Information submitted in accordance with Appendix A and the APS Interconnection Application Process Guide available at www.aps.com/dg. An Interconnection Study may be required depending on the size, configuration, location, and/or operating mode of the Source Transfer Equipment. APS will advise Customer of any such requirement following an initial engineering review of the proposed design.

NOTE: In instances where APS provides multiple (redundant) electric services (feeder sources) to a Customer facility, Customer is prohibited from ever paralleling the Utility services (sources) in a CTT mode, (neither via a Momentary or Smooth or Smooth Parallel Transition transfer) when effecting a power transfer between the services. Refer to the APS ESRM, Section 104.12 “Protection and Isolation Requirements for Multiple Utility Services to a Customer Facility” for additional information.

13.1 Open Transition Transfer Equipment

(A) Open Transition Transfer Switch:

Provided the Transfer Switch is (i) installed in accordance with the NEC and the APS ESRM, and (ii) meets the requirements for a Separate System as specified in Section 4.1 of this document, then Customer will not be required to install a Utility Disconnect and will generally

not be required to enter into an Agreement with APS. Customer shall submit an electrical one-line diagram, and transfer switch specifications in accordance with the APS Interconnection Application Process Guide available at www.aps.com/dg.

(B) Open Transition Transfer Scheme:

Backup Generator Transfer Scheme: If Customer desires to install an open transition transfer scheme in order to transfer to or from a Backup Generator source, that is not tested and certified to UL 1008/1008A, or otherwise does not meet all of the requirements specified for a Separate System in Section 4.1 of this document, then Customer shall submit an Application along with applicable Supplementary Information in accordance with Appendix A and the APS Interconnection Application Process Guide available at www.aps.com/dg. Customer's design shall include a Utility Disconnect(s) as specified in Section 8.2 of this document that will completely isolate Customer's GF from the APS System. Following APS's review and acceptance of the proposed design, APS will develop a Non-Parallel Connection Agreement and possibly an Operating Agreement for execution by APS and Customer. Customer shall not put the Backup Generator into service until the installation has been satisfactorily inspected by APS and written notification has been provided by APS.

Utility Services Transfer Scheme: When Customer installs a transfer scheme in order to perform an open transition transfer from one utility source (service) to another utility source, then the installation shall comply with the requirements outlined in Section 104.12 of the APS ESRM.

13.2 Momentary Parallel Transition

A Momentary Parallel Transition transfer is accomplished by paralleling the Utility and Backup Generator(s) power sources (when both sources are in synchronism) for a time period not to exceed 100 milliseconds (six cycles at 60 Hz) in order to effect a load transfer. Power to the load is not interrupted during the transfer. Such a transfer may be accomplished via either a CTT switch (tested and certified to UL 1008/1008A), or via a CTT scheme (not certified to UL 1008/1008A) and is classified as a Parallel System.

Customer shall submit an Application along with associated Supplementary Information in accordance with Appendix A and the APS Interconnection Application Process Guide, available at www.aps.com/dg, for APS review and acceptance. Following APS acceptance of the proposed design, APS will develop an Interconnection Agreement and possibly an Operating Agreement for execution by APS and Customer.

The requirements outlined in this document for a Parallel System apply to a GF utilizing a Momentary Parallel Transition transfer switch or scheme, including the requirement for a Utility Disconnect(s) as specified in Section 8.2 of this document that will completely isolate Customer's GF from the APS System.

The following additional technical requirements apply:

(A) A primary timer shall be installed to limit the closed transition period to a maximum of 100 milliseconds (six cycles at 60 Hz). The timer shall begin timing when the two power sources are paralleled through their respective circuit breakers (Utility breaker and Generator breaker) and shall trip open either one or the other breaker within the specified time.

(B) In lieu of the minimum protective relaying requirements specified in Section 8.7 of this document, Customer may elect to install a redundant independent backup timer. This backup timer shall be configured to trip, at a minimum, a utility source circuit breaker that is independent of the breakers constituting the transfer switch or scheme in the event the primary timer fails to break parallel between the power sources within the specified time. The backup timer shall:

(1) Begin timing concurrently with the primary timer.

(2) Be set to a maximum time of 1 second.

(3) Directly trip the independent circuit breaker in order to break parallel between the sources in the event of a malfunction (i.e., extended parallel beyond 167 milliseconds) of the normal transfer sequence. The trip circuit shall not be routed through any circuit or logic scheme that could potentially inhibit or block the trip signal, and shall not be routed through a Programmable Logic Controller (PLC) or other such programmable device.

(4) The backup timer and associated circuit design are subject to APS review and acceptance.

(C) For a transfer switch or scheme equipped with a relay incorporating reverse power protective function(s), such function(s) shall be activated for both the Backup Generator and utility source circuit breakers.

For instances where this feature is not available with Closed Transition Transfer switches tested and certified to UL 1008/1008A, APS will not require the reverse power functions.

(D) Overcurrent lockout protection shall be incorporated into the CTT protective relaying scheme to prevent any source breaker from being manually or automatically closed into a fault.

(E) When a transfer switch or scheme is manually operated to transfer load between the power sources, automatic retransfer **is not permitted**.

This requirement correlates with the general safety practice that if a transfer is manually initiated, then the re-transfer also needs to be performed manually.

13.3 Smooth Parallel Transition

A Smooth Parallel Transition transfer is accomplished by synchronizing and paralleling the Utility and Backup Generator power sources for a time period of normally 5 to 15 seconds in order to effect a smooth load transfer (sometimes referred to as “soft loading”) between the sources. Power to the load is not interrupted during the transfer. Such a transfer is accomplished via a CTT scheme (not certified to UL 1008/1008A) and is classified as a Parallel System.

Customer shall submit an Application along with associated Supplementary Information in accordance with Appendix A and the APS Interconnection Application Process Guide, available at www.aps.com/dg, for APS review and acceptance. Following APS acceptance of the proposed design, APS will develop an Interconnection Agreement and possibly an Operating Agreement for execution by APS and Customer.

The requirements outlined in this document for a Parallel System apply to a GF utilizing a Smooth Parallel Transition transfer scheme, including the requirement for a Utility Disconnect

and minimum relaying requirements specified in Section 8 of this document. The following additional technical requirements apply:

(A) Reverse power function(s) shall be activated in the CTT protective relaying for both the Backup Generator and Utility source circuit breakers.

(B) Overcurrent lockout protection shall be incorporated into the CTT protective relaying scheme to prevent any source breaker from being manually or automatically closed into a fault.

(C) When a transfer switch or scheme is manually operated to transfer load between the power sources, automatic retransfer is not permitted.

This requirement correlates with the general safety practice that if a transfer is manually initiated, then the re-transfer also needs to be performed manually.

(D) Prolonged parallel operation greater than 15 seconds of the Customer's GF with the APS System is not permitted nor otherwise agreed upon.

13.4 Closed Transition Transfer Scheme Safety Requirements

The requirements specified in this Section apply to all CTT schemes utilizing a synchronous generator that electrically parallels with the utility source. These requirements supplement those outlined in Sections 13.2 and 13.3 of this document.

All Potential Open Points located in the circuit between a Backup Generator output and the utility source shall be suitably interlocked to preclude the possibility of a potential out-of-sync closure occurring between the two power sources. A Potential Open Point includes any circuit breaker, contactor, switch, or similar device, (referred to as an "Open Point" in this Section) that is capable of being opened and/or closed, and which is not equipped with either a sync check or synchronizing function.

An Open Point may be interlocked by installing either of the following:

(A) A keyed or other suitable mechanical interlock that will prevent the Open Point from ever being opened unless a circuit breaker in the circuit, which is equipped with either a sync check or synchronizing function, is first opened. This breaker, when opened, shall immediately break the electrical path between the power sources.

(B) An electrical interlock consisting of a set of electrical contacts on the Open Point that are directly wired to instantaneously trip open a circuit breaker in the circuit, which is equipped with either a sync check or synchronizing function, whenever the Open Point is opened. This breaker, upon opening, shall immediately break the electrical path between the power sources.

Closed Transition transfer schemes shall also incorporate the following safety features:

(1) Breaker auxiliary switch contacts to provide transfer scheme interlocks and permissive functions that are in addition to any control switching and interlock functions that may be provided by a microprocessor or PLC based control device. The auxiliary switch contacts shall be connected to the appropriate breaker closing/ tripping control paths.

(2) Fail-safe control circuit design to prevent interlocks from being circumvented in the event of loss of control power.

(3) Close defeat cover plates on the transfer scheme source breakers to prevent inadvertent unsafe out of sequence manual operation.

(4) Provisions that allow both of the transfer scheme source breakers to be in the open and racked-out position at the same time to allow the load to be disconnected from both sources.

(5) Overcurrent lockout protection shall be installed to prevent either source breaker from being closed into a fault.

(6) Electrical equipment subject to the paralleled power sources shall be rated to withstand the combined fault current available from the power sources.

(7) Written procedures and/or interlocks to ensure that automatic transfer and retransfer operations are disabled when either of the transfer scheme source breakers is in the racked-out position. This requirement correlates with general safety practices in LOTO switching procedures.

(8) Protection against islanding and out of phase reclosing shall be installed between a Backup Generator and the utility source.

13.5 Main-Tie-Main Transfer Schemes

Main-Tie-Main and Main-Tie-Tie-Main Transfer Schemes (M-T-M Transfer Scheme) typically consist of two or more main source breakers and one or two tie breakers. Such schemes are used to (1) transfer load from one utility source to another, or (2) transfer load between a Utility source and a Backup Generator source (or sources). The requirements for each of these are as follows:

(A) Load Transfer between Utility Sources:

When an M-T-M Transfer Scheme is used to transfer load between Utility sources (services), then the transfer shall be accomplished in an Open Transition Transfer mode to ensure that the Utility sources are never electrically paralleled. The installation shall comply with the requirements outlined in Section 13.1 of this document (refer to “Utility Services Transfer Scheme”) and to Section 104.12 of the APS ESRM.

(B) Load Transfer between the Utility and Backup Generator Sources:

When an M-T-M Transfer Scheme is used to transfer load between a Utility source (service) and a Backup Generator source, then the transfer may be accomplished either in an Open Transition Transfer mode or in a Closed Transition Transfer mode. In addition to the respective requirements previously specified for these two transfer modes, the following common requirements also apply to an M-T-M Transfer Scheme:

(1) When the load is manually transferred between the sources (e.g., to de-energize equipment for maintenance), then any re-transfer of load back to the original source shall only be permitted to be performed in manual (operator supervised and initiated) mode (the transfer scheme shall not permit any automatic re-transfer).

(2) For facilities where multiple Main-Tie-Main Systems co-exist, Customer must ensure that they are properly coordinated.

NOTE: If automatic retransfer logic is part of a standard controller and the logic cannot be modified, then the automatic retransfer logic will need to be disabled and

appropriate placards and procedures need to be put in place as a reminder to personnel.

(C) Excessive fault currents under closed transition conditions may violate the interrupting rating of circuit breakers, or the through fault withstands rating of source transformers, and may damage other connected equipment. Thus, if there is a failure such that the intended main or tie fails to trip, the new source device must automatically be tripped.

14 TESTING AND START-UP REQUIREMENTS

The information outlined in this Section constitutes Start-Up Requirements that apply to any GF. APS may impose additional Start-Up requirements depending on the system impact, type, size, and/or location where the GF is interconnected to the APS System. See sample Site Inspection Plan on www.aps.com/dg. APS will communicate specific testing and/or other additional requirements as soon as practically possible to the Customer prior to final commissioning and/or testing of the GF.

14.1 General Start-Up Requirements

(A) Customer shall, at a minimum, have all specified interface equipment, shutdown and associated protective devices tested and calibrated at the time of installation by qualified personnel and shall also perform functional trip testing of these relays and associated Generator breaker.

(1) Calibration must include on-site bench testing of pickup and timing characteristics of the relays.

(2) Functional testing must demonstrate that each protective relay trip function as required herein, upon a (simulated) out of tolerance input signal, will trip the generator breaker, and shall also include a simulated loss of control power to demonstrate that the generator breaker will open.

(B) Customer must have all equipment installed and certified to any applicable APS, Federal and State requirements and/or codes. **APS may require certifications and/or test reports to be stamped by a Professional Engineer (Electrical) registered in the State of Arizona.**

(C) Customer shall have shutdown testing performed in accordance with IEEE 1547 for abnormal system conditions and provide documentation/proof of such to APS upon request. Additional commissioning tests as required by the equipment standards (i.e., IEEE 1547.1) shall be performed and documentation/proof of such shall be provided to APS upon request.

(D) Customer shall provide a written commissioning test procedure for APS approval to demonstrate required settings and/or modes of operation are in effect.

(E) The Customer is required to have a signed Interconnection Agreement with APS, and must also provide APS with any other required documentation, prior to electrically paralleling the GF with APS's System. The Customer must provide APS with a copy of the Final Electrical Clearance (green tag) for the GF as provided by the AHJ, or provide APS with a duly signed and notarized Letter-in-Lieu of Electrical Clearance if no AHJ electrical inspection is required, before APS will schedule the Site Inspection and meter order.

(F) Customer shall not commence interconnected operation of the GF with the APS System until the GF has been inspected by an authorized APS representative and written

notification is received from APS allowing the GF to commence parallel operation with the APS System.

NOTE: In some cases, a negligible amount of test energy generation may be necessary to test/validate the GF wiring/functionality after receipt of the electrical clearance (green tag) issued by the AHJ, but prior to scheduling APS inspection. Customer assumes all liability in the event the GF causes a hazardous condition for APS, Customer's representatives, general public and any other APS customers. Customer shall request, in writing, permission from APS prior to exporting negligible amount of test energy to validate the GF.

14.2 Static Inverter Systems 1 MW and Larger or any Rotating Machine

(A) The Customer shall provide APS with a certified copy of calibration and functional test results for all GFs comprised of a Rotating Machine and for any GF comprised of Static Inverters with an aggregate AC nameplate rating of 10 MW or larger performed at the time of commissioning of the GF. Customer must also notify APS at least ten (10) business days in advance that such tests are to be performed and allow APS personnel to witness the tests.

(B) For Rotating Machines (Generators), Customer shall repeat such tests performed as specified in Section 14.2(A) at intervals not to exceed four (4) years by qualified test personnel. The Customer shall provide APS with a certified copy of such test results upon request by APS.

(C) The Customer shall give APS at least ten (10) business days prior notice of when initial startup of GF is to begin, and APS will have the right to have a representative present during initial energizing and testing of the GF.

(D) Customer shall provide necessary certification confirming the GF has achieved Qualifying Facility (QF) status as specified in Section 3 of this document.

NOTE: Backup Generators do not qualify as a QF.

(E) Customer shall submit a pre-test calibration and functional test check list, prior to witnessing calibration and functional testing of the GF protective devices (relays) associated with the Generating Facility breaker(s) and full plant trip timing test report for all GF's comprised of Rotating Machines and Static Inverters with an aggregate AC nameplate rating of 10 MW or greater prior to APS witness testing.

(1) Customer shall provide documentation/certification to APS ensuring that the control wiring (along with CT and PT circuitry) has been completed and verified, relay settings have been applied, and any internal trip path testing has been performed (i.e., dry run).

(2) Customer shall provide relay test report(s), equipment test reports (transformers, inverters, generators, etc.) and any other required certification/documentation required by APS prior to granting full permission to parallel with the APS System.

(F) For any GF comprising of Static Inverters with an aggregate AC nameplate rating of 10 MW or larger, Customer shall hire a third-party testing firm to perform full plant trip timing test.

(1) Customer shall provide a test report performed by a qualified testing firm. Test report shall provide trip time, voltage and frequency profile graphs with all inverters on-line (recommend at low power output). Any communication latency between plant equipment at t=0 shall be communicated within the test report.

(2) Customer must notify APS at least ten (10) business days in advance that such tests are to be performed and allow APS personnel to witness the tests. APS, at its option, may elect to connect its test equipment along with, or in lieu of, Customer's test equipment for the purpose of performing the trip timing test.

(3) For the purposes of the trip timing test Customer may be required to disable the Mirrored Bits Receive function at the GF relay(s) for APS Direct Transfer Trip.

15 OPERATIONAL AND MAINTENANCE REQUIREMENTS

15.1 Customer will be responsible for operating and maintaining the GF in accordance with the requirements of all applicable safety and electrical codes, laws and governmental agencies having jurisdiction.

15.2 Customer shall protect, operate and maintain the GF in accordance with prudent engineering and utility practices (Good Utility Practice) and methods. Additionally, Customer shall operate and maintain the GF lawfully in a safe manner and in a non-hazardous condition.

15.3 Customer will allow APS and its authorized agents access to the protective relaying and control facilities to conduct startup or periodic tests APS deems necessary. APS will provide Customer with advance notice of such tests, so that Customer's representatives may be in attendance when tests are performed.

15.4 Customer shall pay annual fees for the Operations and Maintenance (O&M) of APS's new distribution facilities built to accommodate the interconnection of the Customer's GF to the APS System. The Operations and Maintenance Charges (O&MC) covers the costs of the line extension and upgrades and its associate equipment. This O&MC is derived utilizing an APS standard methodology:

(A) Following construction of the dedicated generator tie line, the O&MC is calculated and charged to the Customer based on actual costs of construction.
(B) The actual cost-based O&MC charge will be for the life of the Generator Interconnection Agreement.
(C) The estimated O&MC is the percentage of the actual construction cost (based on the FERC Form-1 data) and is an annual cost to the Customer.
(D) The estimated annual charge will include a 3% escalation for inflation per year over the life of the contract.
(E) Customers required to pay an O&MC will be informed of the fee details during the Interconnection Study process (refer to Section 16.7 of this document).
(F) Behind the Meter/R-DER Customers will not be assessed an O&MC.

15.5 In the event APS or its authorized agents lock open the Disconnect, Customer shall not remove or tamper with such lock.

15.6 APS will be allowed to install on Customer's premises any instrumentation equipment for research purposes. Such equipment will be owned, furnished, installed and maintained by APS.

15.7 APS (including its employees, agents and representatives) shall have the right to enter Customer's premises to:

(A) Inspect Customer's GF, protective devices, and to read or test instrumentation equipment that APS may install, provided that reasonable notice is given to Customer prior to entering its premises;
(B) Maintain, replace or repair APS equipment, which may require APS personnel to open the Disconnect without notice;
(C) Immediately and without prior notice disconnect or cause Customer to immediately disconnect, the GF or otherwise render the GF disconnected from the APS System

(including by opening the Disconnect) if, in APS's opinion, a hazardous condition exists and such immediate action is necessary to protect persons, APS facilities, or other customers' or third parties' property and facilities from damage or interference, or if, in APS's opinion, any of the protective devices or switching apparatus is not or does not appear to be operating properly;

(D) Open the Disconnect without notice if an operating clearance is required by APS personnel;

(E) Close the Disconnect upon completion of APS work performed under an operating clearance.

15.8 Upon termination of the Interconnection Agreement, Customer shall be responsible for ensuring that the Disconnect is immediately opened, and that the electric conductors connecting Customer's generator(s) to the Disconnect are lifted and permanently removed, so as to preclude any possibility of interconnected operation in the future. APS reserves the right to inspect Customer's facility to verify that the generator is permanently disconnected.

16 APPLICATION PROCESS AND GENERAL REVIEW REQUIREMENTS

16.1 For a static inverter-based GF with an aggregate AC output nominal nameplate rating of less than 1 kW that interconnects with the APS System, Customer is not required to submit an Interconnection Application. APS will not inspect the installation or prepare an Interconnection Agreement; however, it remains Customer's responsibility to:

(A) Have the system properly permitted and inspected by the AHJ.

(B) Ensure inverters are tested and certified to UL 1741 per Section 10.2(A)(13).

(C) Conform to all applicable APS interconnection requirements as specified in this document.

16.2 Customers proposing to interconnect a static inverter-based GF are required to submit:

(A) A completed APS Interconnection Application (refer to the APS Interconnection Application Process Guide available at www.aps.com/dg) along with applicable fees.

(B) Diagrams specified per the APS Interconnection Application Process Guide available at www.aps.com/dg.

(C) **For Residential Systems**, when the system design does not follow the standard sample diagrams , Electrical drawings stamped by a Professional Engineer (Electrical) registered in the State of Arizona, may be requested in writing **OR** may be asked to provide a copy of the building permit issued by the AHJ (for applications with no AHJ plan review, refer to Section 16.4 for additional details).

For Commercial Systems, Electrical drawings stamped by a Professional Engineer (Electrical) registered in the State of Arizona.

NOTE: APS may require a copy of the building permit issued by the AHJ when specifically required by Utility in writing (for applications with no AHJ plan review, refer to Section 16.4 for additional details).

16.3 An "Interconnection Application" must be submitted, and all Supplemental Information requested per Appendix A and the APS Interconnection Application Process Guide shall be provided.

Additionally, diagrams shall be prepared and submitted per requirements specified (refer to Appendix A and the APS Interconnection Application Process Guide and in the format depicted on APS Sample Diagrams located at www.aps.com/dg.

APS will review the Customer provided documentation to determine if the design conforms to APS's requirements. APS reserves the right to require diagrams submitted to be stamped by a Professional Engineer (Electrical) registered in the State of Arizona.

APS notification that the system design appears to be in conformance with APS's Interconnection Requirements does not represent APS' approval of system's design, nor is it an assurance that the system complies with all applicable electric codes, laws, regulations and requirements applicable to its installation and operation.

The building permit, when requested/required, shall be issued by the AHJ following their approval of the diagrams and not the "permit application" form.

It is not necessary to submit a building permit and/or permitted diagrams for 1 MW or greater Static Inverter based systems or Rotating Machines to begin the APS Interconnection Application review.

Note that APS may accept a set of the required diagrams (normally one-line, three-line, array, plant location and site plan) approved by the AHJ provided these diagrams have been prepared in accordance with the APS Sample Diagrams and contain the necessary information shown therein and as otherwise specified in Appendix A of this document and the APS Interconnection Application Process Guide available at www.aps.com/dg.

16.4 Depending on the GF type and size, APS will review the Interconnection Application and required diagrams for consistency with APS Interconnection Requirements and provide comments back to Customer or their designee. Diagrams must be in compliance with all NEC, APS, and AHJ requirements. APS will not generally require re-submittal of the Interconnection Application or required diagrams unless the diagrams or system design is revised prior to scheduling APS Site Inspection, or APS requests a resubmittal. As a part of the APS Site Inspection, APS will inspect to ensure all applicable diagram comments made by APS have been incorporated.

If there is no plan review or permit requirement imposed by the AHJ, drawings must be submitted per the APS Interconnection Application Process Guide available at www.aps.com/dg. A notarized copy of APS' Letter-in-Lieu of Electrical Clearance form is required. Per 16.2 drawings may need to be stamped by an Electrical PE in Arizona. If the installation is a Supply Side Connection, a Third-Party Inspection will be required, and the completed report will be submitted to APS upon request. See the APS Interconnection Application Process Guide available at www.aps.com/dg for additional details.

NOTE: Diagram reviews by APS do not relieve Customer of the responsibility of full compliance with the APS Interconnection Requirements and all applicable building and safety codes, and local permitting requirements.

16.5 APS's review of documentation submitted by Customer or their designee shall not be construed as a warranty or representation regarding the safety, durability, reliability, performance or fitness of Customer's GF and service facilities (i.e., SES), its control or protective devices, or the design, construction, installation or operation thereof.

16.6 APS strongly encourages Customer to work closely with APS at the conceptual stages of the design to ensure that the project proceeds smoothly. A single point of contact with which to coordinate the interconnection process is preferred.

16.7 Following receipt of Customer's Interconnection Application, APS will determine if an Interconnection Study (Study) is required based on ACC Interconnection Rules and/or APS requirements outlined herein. For details of each Study track, please see A.A.C. R14-2-2617 (Level 1 Super Fast Track), A.A.C. R14-2-2618 (Level 2 Fast Track) and A.A.C. R14-2-2618 (Level 3 Study Track). Systems rated at 1 MW or greater generator AC output nominal nameplate rating will require an engineering review/evaluation and/or Study (Schedule 6 may apply) as determined by APS. APS may also perform a Study on any proposed GF with an AC nameplate rating of less than 1 MW in the event an Interconnection Application fails an Interconnection Application Screen as outlined in Section 16.8.

The Study determines whether any modifications, upgrades or additional facilities will be required to the APS System. The Study will also provide estimated costs for

equipment additions required including APS System upgrades to interconnect the GF to the APS System. Additionally, the Study will determine any special technical requirements needed. Customer will be responsible for any costs associated with upgrading the APS System in order to accommodate interconnection of the GF. Payment of Interconnection Study fee(s) along with a construction agreement/invoice will be required prior to developing project milestones/schedules. APS reserves the right to cancel any Interconnection Application not interconnected within 180 calendar days after approval with notification to the customer. In addition, If Customer requires additional time beyond 180 calendar days to complete an Interconnection project, the Customer can request a one-time 90-day extension as referenced in ACC Interconnection Rules Section R14-2-2604.

NOTE: When APS requires compliance with Section 11 herein, additional time will be required to procure, install and test/commission the necessary equipment to interconnect the GF with the APS System.

16.8 After APS review of Customer's Interconnection Application, all inverter-based GFs will be subject to Interconnection Application Screens, as outlined in Appendix B, based on engineering analysis for reliability, voltage, and protection of the distribution infrastructure specific to location and proposed system size. In the event an Interconnection Application fails any number of Screens as outlined in Appendix B of this document, Customer will be notified that their Application will require additional review. APS may require that an Interconnection Study be performed to determine additional requirements necessary to approve an Application, as well as to identify solutions that may be implemented to allow interconnection of the GF. If the Generating Facility's operating characteristics can be modified such that improvements to the Distribution System are reduced or not required, and both the Utility and Customer agree on the operating characteristics, the Customer shall have the opportunity to modify the Generating Facility's operating characteristics to reduce facility costs. Additional study deposits may apply (Refer to Appendix C). Check www.aps.com/dg for the latest information pertaining to interconnecting a DG facility (or facilities) to the APS System. The Customer and/or Customer's representative may request a Pre-Application Report as referenced in ACC Interconnection Rules A.A.C. R14-2-2616 in order to determine if interconnecting at a specific location within the APS System is feasible or not.

16.9 APS will provide Customer with the estimated costs and construction schedule should it be necessary for to upgrade the APS System (i.e., install Dedicated Utility Feeder(s), control or protective devices, remote terminal unit(s), etc.) in order to accommodate or protect Customer's GF or APS equipment. Customer will be responsible for all costs incurred to the extent they exceed those normally incurred by APS for Customers who do not have self-generation facilities, and which must be paid prior to the commencement of any such work.

16.10 Following APS's final Site Inspection of the Customer's Generating Facility, Customer shall not remove, alter, or otherwise modify or change the equipment specifications, including, without limitation, the plans, control and protective devices or settings, and in general the Generating Facility system configuration or any facilities appurtenant thereto that are subject to the APS Interconnection Requirements. If the Customer desires to make such changes or modifications, the Customer must resubmit to APS revised plans describing the changes or modifications for review by APS. No change or modification may be made without the prior written acceptance of APS. Note that APS will not require a resubmittal of a submitted

Interconnection Application for any Minor Modifications as defined herein and as referenced in ACC Interconnection Rules Section R14-2-2610.

16.11 Following APS' review of Customer's Interconnection Application and associated diagrams, APS will prepare the Interconnection Agreement, and any applicable other agreements (e.g., Electric Supply/Purchase Agreement, Construction Agreement, Line Extension Agreement, and Operating Agreement) and/or other required documents for execution by APS and Customer.

16.12 Rotating (Backup) Generators, which are not subject to ACC Interconnection Rules, shall submit a completed Interconnection Application along with applicable fees and all Supplementary Information as required by Appendix A and the APS Interconnection Application Process Guide available at www.aps.com/dg, APS will generally require 4-6 weeks for review. APS may require additional time depending on the size and complexity of any such GF. APS will communicate with the Customer's representative should additional time be required for review as soon as practically possible. Customer should discuss project plans with APS before designing its DG or purchasing and installing equipment.

APS Contact

For questions about the APS Interconnection process, general requirements, or other related information contact:

APS Renewable Energy Team

Email: renewables@aps.com

Number: 1-800-253-9405 or 602-371-7171

Mail: APS Renewable Energy Team

MS 3200

PO BOX 53933

Phoenix, AZ 85072-3933

For questions about the FERC Interconnection process, general requirements, or other related information, please email interdev@apsc.com.

APPENDIX A: SUPPLEMENTAL INFORMATION

Diagrams, Specification Sheets and Documents noted below are to be specifically prepared for APS' use, and shall be submitted in pdf format. In addition, a copy of the building permit issued by the AHJ may also be required.

Drawings must be site specific, without extraneous information and must be prepared for APS's use. All electrical connections to equipment must be shown – "block diagrams" will be rejected. Diagrams are to be professionally drawn, using only black print on white paper, and are not to be in color or shaded. Free hand drawn, faxed diagrams and drawings that are otherwise difficult to read on 11" X 17" print will not be accepted by APS.

All diagrams must include the project name and street address and include any updated diagram revision numbers and dates. If the required information is not provided on the drawings, application and/or supplemental information, then APS will require clarifying information. Clarifying information may include requesting manufacturers cut sheet(s) or the UL certification documents for the device/equipment in question. Refer to Section 16.2, 16.3 & 16.4 of the APS Interconnection Requirements for additional information.

The following table identifies specific document requirements for the application type. Please note there may be additional documentation required to complete an interconnection application. Additional application requirements are specified within the APS Interconnection Application Process Guide. In addition, APS has prepared several Sample Diagram sets that indicate the general layout, level of detail, keyed notes, and other information, with the quality required by APS for typical inverter-based systems. These diagrams and APS Interconnection Process Guide are located at: www.aps.com/dg

Required Drawings/Specs/Docs	Static Inverters	Rotating Machinery	Separate Service Generators
Electrical One-Line	X[1]	X	X
Electrical Three-Line	X		
Plant Location	X[1]	X	
Site Plan with Elevation Plan	X	X	
Battery Specification Sheets[2]	X		
AC & DC Control Schematics[3]	X	X	
Generator and Transfer Switch Specification Sheets			X
Relay Setting Sheet(s)[3]	X	X	
Commissioning Plan[3]	X	X	
Sequence of Operations	X	X	
Manufacturer Switchgear Shop Drawings[3]	X	X	

[1] Diagrams will not be required for Residential Static Inverter Generating Facilities.
[2] Required for all BESS Generating Facilities.
[3] Required for Generating Facilities with AC Aggregate Nameplate Rating of 1 MW or Greater and all Rotating Machines.

APPENDIX B: INTERCONNECTION APPLICATION SCREENS

The following Screens may be applied to any/all proposed inverter based Generating Facility (GF) connecting to a non-network APS distribution circuit. If any Application Screens indicate that the GF may negatively impact the circuit, Customer will be notified along with course of action as noted in Section 16.8 of this document. ACC Interconnection Rules require that an Interconnection Application must pass specific Screens noted below in order to utilize the Fast Track or Super-Fast Track process. Refer to ACC Interconnection Rules R14-2-2617 and R14-2-2618 for additional details. The following description of each Screen is the APS interpretation of the ACC Screen Language.

Screen	Description
A	Is the aggregated generation, including the proposed Generating Facility, on the circuit less than 15% of the total circuit annual peak load or the circuit hosting capacity limit (whichever is greater)? (Y/N)
B	Is the proposed Generating Facility fault current contribution less than 10% of the distribution circuit's maximum fault current value at any point on the distribution system? (Y/N)
C	Is the aggregate Maximum Capacity of existing generation facilities, including the proposed Generating Facility's Maximum Capacity, connected to the proposed distribution circuit less than 90% of any distribution protective devices and equipment short circuit interrupting capability? (Y/N)
D	Is the distribution circuit of the proposed Generating Facility effectively grounded with a system neutral (e.g., 3-phase, 4-wire, 1-phase, 3-wire)? (Y/N)
E	Is the aggregate capacity on 1-phase shared secondary including the proposed Generating Facility <= 75% of transformer kVA rating? (Y/N)
F	Will the proposed Generating Facility, connected to a 1-phase system connected to a transformer providing a 120/240V secondary service, current imbalance be <= 20% of the nameplate rating of the service transformer between the two sides of the 240 Volt service? (Y/N)
G	Is the proposed Generating Facility, in aggregate with other generation interconnected to the distribution side of the substation transformer feeding the distribution circuit, less than 10 MW in an area where there are known or posted transient stability limitations to generating units located in the general electrical vicinity? (Y/N)
H	Is the POI of the proposed Generating Facility connected to a distribution circuit (i.e., not connected to sub-transmission or transmission circuit with a line voltage >= 69 kV)? (Y/N)
I.1[1]	Is the aggregate AC nameplate current rating of the proposed Generating Facility <= the current rating of the Customer's existing electrical service? (Y/N)
I.2[1]	Does the customer have a request to upgrade their existing electrical service? (Y/N)
J	Is the Generating Facility inverter based? (Y/N) If no, the Generating Facility must comply with the Protective Function requirements and any additional Utility Interconnection requirements specified by the Utility in its Interconnection Manual.

[1] NOTE: It is required that the Customer pass either Interconnection Application Screen I.1 or I.2 in addition to applicable/required screens identified above to be approved for the Level 2 Fast Track process as outlined in the ACC Interconnection Rules.

APPENDIX C: ESTIMATED DEPOSIT TABLE

In accordance with ACC Interconnection Rules, the following table of estimated deposits shall be applied depending on specific application track and results of applicable Screens (See Appendix B). Any/all deposits shall accompany an Interconnection Study Agreement. Refer to Section R14-2-2617, R14-2-2618, R14-2-2619 & R14-2-2620 of the ACC Interconnection Rules for additional details.

Table C.1 *Estimated Deposits*

	Facility Size	Supplemental Study Deposit	Feasibility Study Deposit	System Impact Study Deposit	Facility Study Deposit
R-DER	Under 20 kW	$ -	$ -	$ -	$ -
	20 kW-250 kW	$500.00	$1,000.00	$2,000.00	$3,000.00
	250-499kW	$1,000.00	$1,250.00	$2,500.00	$3,750.00
	500-999kW	$1,500.00	$2,500.00	$5,000.00	$7,500.00
	1-2MW	$2,000.00	Refer to Schedule 6		
U-DER[1]	2-5MW[2]	$3,000.00			
	5-10MW	$5,000.00			
	10+MW	$7,500.00			

[1] Threshold requirements for Dedicated Utility Feeder subject to Section 11.5(G).
[2] Systems within the 2-5 MW range may not require a Dedicated Utility Feeder subject to technical/geographic area specific requirements.

APPENDIX D: RATE SCHEDULES APPLICABLE TO DISTRIBUTED GENERATION

APS Rate Schedules and Rate Riders

There are various rate schedules and rate riders applicable to Customer owned generation that electrically parallels with the APS electric distribution system. Note that participation under a particular rate schedule or rate rider is subject to the GF qualifying for that specified rate schedule or rate rider.

These rate schedules and rate riders are available at www.aps.com.

The rates specified do not apply to backup or standby generation that is used solely for emergency purposes, and that parallels with the Utility for brief periods in order to effect a power transition from the Utility to the backup generation and vice versa.

Rates Disclaimer

1. APS electric rates, basic charges and service fees are subject to change. Future adjustments to these items may positively or negatively impact any potential savings or the value of Customer's GF.
2. Customer will be responsible for paying any future increases to electric rates, basic charges or service fees from APS.
3. Customer's GF is subject to the current rate schedules and rate riders, rules and regulations established by the ACC. The ACC may alter its rules and regulations and/or change rates in the future that could directly impact the economics of Customer's GF.
4. APS and/or the ACC do not sponsor or approve any future electric rate projections presented to Customer. These rates are based on projections formulated by external third parties not affiliated with APS and/or the ACC.

System Size Limiting Factors

1. System sizes are limited by the following factors:
   a. For all qualifying residential and non-residential facilities, system sizes are subject to the requirements found in the Arizona Administrative Code of Distributed Generation Interconnection Requirements (AAC DGIRs). As such, proposed system size must pass the application, screening, and approval process as set forth in the AAC DGIRs.
   b. For all qualifying non-residential DG systems utilizing the EPR-6 rate rider, no system may exceed 125% of connected load for its meter, where connected load is defined as the maximum demand divided by 0.6.
2. Additional system sizing information to note:
   a. In alignment with Industry standards, APS utilizes a DC/AC conversion factor of 85% (AC = 0.85 X DC).
   b. Service entrance equipment is the jurisdiction of both the Utility and the Authorities Having Jurisdiction (Non-APS entities). This equipment also limits system sizes and may be required by the AHJ to be sized to accommodate the customers proposed system.

ATTACHMENT B

INTERCONNECTION MANUAL

REDLINE

Interconnection Requirements

For

Distributed Generation

Arizona Public Service Company

~~Effective XX-XX-2021~~
Submitted to Arizona Corporation Commission May 06, 2022
Rev. ~~8.5~~ 9.0

APS Interconnection Requirements for Distributed Generation
Statement of Ownership

This Interconnection Requirements manual is owned and maintained by the APS Distributed Resources Engineering team. Originally published by APS in June 1985, this document continues to be updated to address evolving industry standards, industry recommended practices, safety concerns, technology advancements, and regulatory requirements. This document is updated and approved via committee with input from various internal and external groups. Internal input is obtained from APS departments such as System Protection ~~Engineering~~, SCADA, Operations, Meter Shop, Legal, Regulatory, Program, Technical Projects, Safety, and Interconnection. External input is obtained from various industry experts and interested parties, including Generating Facility designers and installers, consulting engineers, electric utilities, and equipment manufacturer representatives. Any questions or suggestions regarding this document should be directed to the APS Distributed Resources Engineering team.

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1 INTRODUCTION

This document specifies the minimum requirements for safe and effective operation of any Distributed Generation electrically interconnected (or paralleled) with the Arizona Public Service Company (APS or Company) distribution system (21 kV or less). APS Customers and/or Customer's authorized representatives and APS personnel shall use this document when planning for the installation of any Backup Generator or Generating Facility (GF). Application for interconnection is made by completing and submitting to APS the applicable Interconnection Application. The APS Interconnection Application Process Guide is available at www.aps.com/dg.

Interconnections on the distribution system that do not sell power for resale will follow the process outlined by the Arizona Corporation Commission (ACC) with the following tracks:

- R14-2-2617 Level 1 Super Fast Track – A customer interconnecting an inverter-based Generating Facility with a Maximum Capacity of 20 kW or less, which only uses Certified Equipment.
- R12-2-2618 Level 2 Fast Track – A customer interconnecting a Generating Facility with a Maximum Capacity of less than 2 MW, excluding a Generating Facility processed in accordance with R14-2-2617.
- R14-2-2619 Level 3 Study Track – A customer interconnecting a Generating Facility with a Maximum Capacity of 2 MW or greater, or a Generating Facility that does now meet the screening requirements for Level 1 Super Fast Track, Level 2 Fast Track, or transfer from Supplemental Review.
- R14-2-2620 Supplemental Review – If a Utility determines that an Application for Interconnection cannot be approved without conducting a Supplemental Review, or if requested by the Applicant.
- R14-2-2623 Expedited Interconnection Process – A customer interconnecting a Non-Exporting inverter-based energy storage Generating Facility or an Inadvertent Export Generating Facility with a Maximum Capacity of 20 kW or less may apply for interconnection under the Expedited Interconnection Process. In order to qualify for the Expedited Interconnection Process, the customer's Generating Facility must meet the applicable conditions specified in subsection (B) and (C) of R14-2-2623.

Detailed information can be found at the following website:

https://apps.azsos.gov/public_services/title_14/14-02.pdf.

Installations that are directly connected to the transmission system or sell power for resale, except in limited circumstances described later, have additional APS requirements. In such cases an interconnection application may need to be made in accordance with APS's Open Access Transmission Tariff (OATT). Further information can be obtained by accessing the following website: www.oatioasis.com/azps/index.html and clicking on the link entitled Applications.

If a generator interconnects to the APS transmission system (higher than 21 kV), and is not subject to APS's OATT, such interconnection may be performed in accordance with this document. APS will work with Customer and advise of additional requirements.

These requirements may not cover all details in specific cases. This document must be applied in conjunction with the following APS documents that pertain to the parallel operation of Customer-owned Distributed Generation with the APS System:

- Schedule #1, Terms and Conditions for Standard Offer and Direct Access.
- Schedule #2, Terms and Conditions for Energy Purchases from Qualified Cogenerators and Small Power Production Facilities.
- Schedule #4, Totalized Metering of Multiple Service Entrance Sections at A Single Site for Standard Offer and Direct Access Service.
- Schedule #5, Guidelines for Electric Curtailment.
- Schedule #6, Interconnection Services and Fees for Non-FERC Generation Facilities.
- APS Electric Service Requirements Manual (ESRM).

The Service Schedules listed are available via www.aps.com.

The ESRM is available at: www.aps.com/ESRM.

The minimum required protective relaying and/or safety devices and requirements specified in this document~~,~~ are for protecting only APS facilities and the equipment of other Customers from damage or disruptions caused by a fault, overcurrent condition, malfunction, or improper operation of the GF. These requirements are also necessary to ensure the safety of utility workers and the public. Minimum protective relaying and interconnection requirements do not include additional relaying, protective or safety devices as may be required by industry and/or government codes and standards, equipment manufacturer requirements and prudent engineering design and practice to fully protect the Customer's GF. Those additional relaying, protective or safety devices are the sole responsibility of such Customer.

In addition to all applicable regulatory, technical, safety, and electrical requirements and codes, which are not contained in their entirety in this document, Customers are also subject to contractual and other legal requirements, which may only be summarized or referenced in this document. Those regulations, requirements, contracts and other materials contain complete information concerning interconnection and govern over the general provisions in this document.

The technical interconnection requirements outlined in this document also apply to any interconnected utility-owned or operated GF.

This document, as well as the various Agreements and rate schedules, is subject to revision and Commission oversight. Check with APS, or go to www.aps.com/dg, for the latest revision prior to commencing your project.

APS is committed to ensuring that Interconnection Applications are handled promptly, and to do everything possible to complete the interconnection process in a safe and timely manner. At APS, we look forward to working with you to ensure a successful generation project.

2 DEFINITIONS

The following capitalized terms, as used in this document, shall have the meanings specified:

Advanced Inverter: A grid interactive Static Inverter with functions to allow for more elaborate monitoring and communication of the grid status, the ability to receive operation instructions from a centralized location, and the capability to make autonomous decisions to improve grid stability, support power quality, and provide ancillary services such as voltage regulation, power factor control and reactive power control.

Advanced Metering Infrastructure (AMI): The APS-owned Metering system whereby electrical meters transmit electric usage and other data via a radio and/or cell phone communication system to a central data collection system.

Agreement: See "Interconnection Agreement."

ANSI: American National Standards Institute. See www.ansi.org.

Application (also referred to as the **Interconnection Application):** The standard form as specified/referenced in the APS Interconnection Application Process Guide available at www.aps.com/dg.

APS: Arizona Public Service Company.

APS Interconnection Requirements: The requirements set forth in this document entitled "Interconnection Requirements for Distributed Generation Arizona Public Service Company" and all additional requirements that are referenced in this document.

APS System (also referred to as the **Utility System):** Refers to APS's Electrical Transmission or Distribution System.

Arizona Administrative Code (A.A.C~~).~~.) Article 26, Interconnection of Distributed Generation Facilities (ACC Interconnection Rules): Polices, processes and timeframes which governs how APS and the Customer will interconnect a GF operated in continuous parallel with the APS System.

Arizona Corporation Commission (ACC or **Commission):** The regulatory agency of the State of Arizona having jurisdiction over public service corporations, including APS, operating in Arizona. See www.azcc.gov

Authority Having Jurisdiction (AHJ): The organization, office, or individual responsible for enforcing the requirements of a code or standard or for approving equipment, materials, an installation, or a procedure.

Backfeed: To energize any section of the APS System from an electric source other than the normal utility source.

Backup Generator: An independent power generation source or sources located at a Customer's facility installed for the sole purpose of supplying on-site generated power to Essential Loads upon failure or outage of the normal ~~Utility~~utility source. A Backup Generator shall be understood to include Critical, Emergency and Standby Power Systems as defined in IEEE Std. 446 and the NEC.

Behind the Meter (BTM): A term used to describe a power generation application in which the GF generation is not directly interconnected to the APS System but rather, to a Customer-owned electric

system that is itself electrically connected to APS System via an APS retail billing meter. A BTM application is commonly referred to as a R-DER.

Bi-Directional Meter: A meter having two separate metering registers, one to record electricity delivered to Customer and the other to record electricity received from Customer.

Business Day: Monday through Friday, excluding Federal and Arizona State holidays.

Clearance: A statement by one having complete authority over all parts of a circuit or piece of electrical equipment that said circuit or equipment is disconnected from all known sources or power. It is assurance that all proper precautionary measures have been taken and workers may proceed with grounding the circuit.

Clearance Point: The physical location on a section of a power line or equipment that is to be visibly disconnected from all known power sources of power.

Closed Transition Transfer (CTT): The transfer of electrical load between two power sources (normally the Utility grid and Customer's Generator) in which the power sources electrically synchronize and parallel for a period of time to transfer load between the power sources without interrupting power to the load. This is also referred to as a "make-before-break" Transfer Switch or Scheme. A CTT may be accomplished by either a Momentary Parallel Transition or a Smooth Parallel Transition.

Cogeneration Facility: Any facility that sequentially produces electricity, steam or forms of useful energy (e.g., heat) from the same fuel source and which are used for industrial, commercial, heating, or cooling purposes.

Continuous Parallel: A GF that electrically parallels with the APS System for more than 15 seconds.

Customer: An APS account holder or APS "Customer of Record" that receives electric service from APS and which may also generate electricity at the property receiving electric service. A Customer shall be understood to include any independent party or entity that either invests in, owns or operates the GF including without limitation its grantees, lessees or licensees.

Dedicated Utility Feeder: A Distribution System feeder placed into service with the sole purpose of serving a single Customer. A non-Dedicated Utility Feeder (sometimes referred to as a Shared Feeder) serves multiple Customers. A Dedicated Utility Feeder may be required to serve a U-DER meeting criteria outlined in Section 11.5(G).

Utility Disconnect ~~Switch:~~(Disconnect): A visible open disconnect device that Customer is required to install and maintain in accordance with the requirements set forth in this document. It will completely isolate Customer's GF from the APS System, including the ~~Utility~~utility metering equipment located at the SES.

Distributed Energy Resource (DER): A source of electric power that is connected to the APS System, either Behind the Meter in the Customer's premise, or on the Utility's primary distribution system. A DER shall include either/or Generators and Energy Storage technologies capable of exporting active power to the APS System.

Distributed Generation (DG): Any type of electrical Generator, Static Inverter or GF interconnected with the APS System that either (a) has the capability of being operated in electrical parallel with APS's System, or (b) can feed a Customer load that can also be fed by the APS System. A DG facility is also referred to as a Generating Facility or GF in this document.

Distribution System: The infrastructure constructed, maintained, and operated by APS to deliver electric service at the distribution level (21 kV or less) to retail Customers. This is also referred to as the APS System or APS's System.

Electric Service: Service provided by APS to Customer in accordance with all applicable APS requirements, including but not necessarily limited to APS Service Schedule 1 (Terms and Conditions for Standard Offer and Direct Access Services) and the APS ESRM, whereby electricity may be delivered by APS to Customer, or electricity may be received by APS from Customer.

The APS Service Schedules are available at www.aps.com.

EMS Meter (Energy Management System Meter): A Bi-Directional Meter installed at the GF SES that measures and records instantaneous Watts, kVA, kvars, Volts, Power Factor, Amps, and cumulative kWh (generally at 5-minute incremental data for reporting), which has the capability to transmit such data via a Remote Terminal Unit back to APS for planning, forecasting and billing purposes.

Energy Storage (ES): The capture of energy produced at one time for use at a later time. A device that stores energy with the potential to Backfeed.

ESRM: APS Electric Service Requirements Manual. See www.aps.com/ESRM.

Electric Supply/Purchase Agreement: An agreement, together with appendices, signed between APS and Customer covering the terms and conditions under which electrical power is supplied to and/or purchased from APS.

Essential Loads: Electrical loads as determined by Customer requiring 24-7 reliable continuous AC power.

Exporting System: Any type of Generating Facility that is designed to regularly Backfeed the Distribution System.

Facilities Study (FaS): A full comprehensive analysis of the actual construction requirements for the APS power delivery system, based on the information from the Feasibility Study and System Impact Study or equivalent information provided by the Customer or Customer's representative or third party. The FaS will provide the detailed costs of construction and milestones associated with the requirements. Construction may include new circuit breakers, relocation of reclosers, new utility grid extensions, reconductoring of lines, new transformers, protection requirements and interaction.

Fault Current: The level of current that can flow if a short circuit is applied to a voltage source.

Feasibility Study (FeS): A preliminary review study will assess the expected capacity requirements of the proposed generator on the delivery system compared with the available system capacity at the point of interconnection, identify any potential overload issues for the delivery system, review of short circuit currents (including contribution from the generator), as well as coordination of distribution circuit protection devices. Additionally, this study will provide an initial assessment of the complexity and likely costs for the interconnection.

FERC: Federal Energy Regulatory Commission.

Generating Facility (GF): All or part of Customer's electrical Generator(s) and/or Energy Storage together with all protective, safety, and associated equipment and improvements associated with the interconnection to, or operation in conjunction with, the APS System.

Generator: A Rotating Machine or Static Inverter used to produce electrical power.

GF: See Generating Facility.

Good Utility Practice: Any of the practices, methods, and acts engaged in or approved by a significant portion of the electric industry during the relevant time period, or any of the practices, methods, and acts which, in the exercise of reasonable judgment in light of the facts known at the time the decision was made, could have been expected to accomplish the desired result at a reasonable cost consistent with good business practices, reliability, safety, and expedition. Good Utility Practice is not intended to be limited to the optimum practice, method, or act to the exclusion of all others, but rather to be acceptable practices, methods, or acts generally accepted in the region.

IEEE: The Institute of Electrical and Electronic Engineers. See www.ieee.org/index.html.

Inadvertent Export: The unplanned, uncompensated transfer of electrical energy from a Generating Facility to the Distribution System across the Point of Interconnection.

Interconnection: The physical connection of Customer's GF with the APS System.

Interconnection Agreement (also referred to as an **Agreement**)**:** An agreement, together with appendices, signed between APS and Customer, covering the terms and conditions governing the Interconnection and parallel operation of the GF with APS.

Interconnection Application (refer to **Application**)**:** An application form and all supplementary information specified in Appendix A and the "APS Interconnection Process Guide" available at www.aps.com/dg.

Interconnection Application Screens (also referred to as **Screens**)**:** A series of technical evaluations performed by APS upon the receipt of an Interconnection Application in order to determine a proposed GFs impact on the APS System. Refer to Section 16.8 and Appendix B for additional information regarding Screens. Screens noted in Appendix B are consistent with ACC Interconnection Rules, A.A.C. R14-2-2615.

Interconnection Generation Design Review Agreement (also referred to as an **Interconnection Study Agreement**)**:** An agreement signed between APS and Customer covering the terms for APS to proceed with a detailed study (i.e., Interconnection Study) of the impact of Customer's DG on the APS System.

Interconnection Study (Study): A study or studies that may be undertaken by APS (or an APS designated third-party) in response to its receipt of a completed Application for Interconnection and parallel operation with the APS System. Interconnection Studies may include, but are not limited to, Interconnection Feasibility Studies, System Impact Studies, and Facilities Studies.

Island: A condition in which a portion of a ~~Utility~~utility electric power system is energized solely by one or more local electric power systems throughout the associated Point of Interconnection while that portion of the ~~Utility~~utility electric power system is electrically separated from the rest of the ~~Utility~~utility electric power system.

Main-Tie-Main (or Main-Tie-Tie-Main): A Transfer Scheme consisting of two main power source breakers and one or two tie breakers, designed such that electrical load can be transferred between two power sources.

Maximum Capacity: Refers to a~~.~~)) the nameplate AC capacity of a Generating Facility; or b~~.~~)) only the power transferred across the Point of Interconnection to the Distribution System, not including Inadvertent Export, if the Operating Characteristics of the Generating Facility limit the power

transferred across the Point of Interconnection to the Distribution System~~, only the power transferred across the Point of Interconnection to the Distribution System, not including Inadvertent Export~~.

Metering: The function related to measuring the transfer of electric power and/or energy.

Meter Disconnect: A ~~lockable~~visible open disconnect device ~~or switch~~ that is lockable in accordance with OSHA Lock Out Tag Out (LOTO) requirements (i.e., OSHA 1910.147B), and located within the same workspace as the production meter. Customer is required to install and maintain this device in accordance with the requirements set forth in this document~~.~~ and the APS ESRM. It will completely isolate APS required Generator Metering from any power source(s).

Meter Socket Adapter (MSA): A device installed at the customer-owned Service Entrance Section (SES) between the meter socket in the Customer's SES and the APS revenue meter that will accept a wired connection directly from a Customer's Generating Facility, or GF.

Microgrid: A group of interconnected loads and distributed energy resources with clearly defined electrical boundaries that acts as a single controllable entity with respect to the grid and can connect and disconnect from the grid to enable it to operate in both grid connected or island mode.

Minimum Protective Devices, Relays, and Interconnection Requirements: The minimum required protective relaying and/or safety devices or requirements specified in this document, as may be revised from time to time, for the purpose of protecting only APS and its other customer facilities from damage or disruptions caused by a fault, malfunction, or improper operation of Customer's GF. Minimum Protective Relaying and Interconnection Requirements do not include relaying, protective or safety devices as may be required by industry and/or government codes and standards, equipment manufacturers and prudent engineering design and practice to fully protect Customer's GF or facilities; those are the sole responsibility of Customer.

Minor Modifications: Modifications such as grammatical errors as provided within the Interconnection Application and/or the provided Interconnection Diagrams as required per the APS Interconnection Application Process Guide available at www.aps.com/dg. Additionally, "like-for-like" modifications are permitted such as make/model of electrical equipment ~~just as long as~~provided electrical ratings and equipment listings remain unchanged (i.e., inverter AC nameplate ratings) ~~in which a compromise to~~and technical requirements are not violated.

Momentary Cessation: A protective mode when no current is injected into the grid by the inverter during low or high voltage conditions outside of its continuous operating range. This is accomplished by blocking the power electronics' firing commands and the inverter does not produce real or reactive current.

Momentary Parallel Transition: A form of Closed Transition Transfer in which the transfer of electrical load between two power sources occurs by electrically paralleling the power sources for a brief period of time in order to affect a rapid transfer of load between the power sources. A Momentary Parallel Transition is accomplished by paralleling the power sources for a period not to exceed ten cycles.

NEC: National Electric Code. See www.nfpa.org/nec.

NEMA: National Electrical Manufacturers Association. See www.nema.org.

NERC: North American Electric Reliability Corporation. See www.nerc.com.

Network: An AC power distribution system that includes automatic protective devices intended to isolate the network from faulted feeders while maintaining uninterrupted service to the Customer.

Network service typically includes multiple parallel services fed via multiple parallel feeders and may include (if served via secondary voltage class) parallel step-down transformation.

NFPA: National Fire Protection Association. See www.nfpa.org.

NFPA 70E: Standard for Electrical Safety in the Workplace.

Non-Exporting System: A system in which there is no designed, regular export of power from the Generating Facility to the Distribution System.

Non-Parallel Connection Agreement: An agreement, together with appendices, signed between APS and Customer, covering the terms and conditions governing the non-parallel connection and operation of the GF with APS.

Non--Wires Solutions (NWS): An electricity grid investment or project that uses non-traditional T&D solutions, such as distributed generation, energy storage, energy efficiency demand response, and grid software and controls, to defer or replace the need for specific equipment upgrades, such as T&D lines or transformers, by reducing load at a substation or circuit level.

NRTL: Nationally Recognized Testing Laboratory.

Operating Characteristics: The mode of operation of a Generating Facility (Exporting System, Non-Exporting System, or Inadvertent Exporting System) that controls the amount of power delivered across the Point of Interconnection to the Distribution System.

Operations Center: A Customer-owned facility in which monitoring and/or control of the GF occurs. The Operations Center can be a combination of automatic and manual controlled/monitored devices (i.e., relays, generator controllers, switches, etc.) to ensure the reliability and safe operation of the GF. The operations center is generally manned 24-7 and shall be reachable via APS.

Open Transition Transfer: The transfer of electrical load between two power sources (normally the Utility grid and Customer's Generator) in which the power sources are prevented from being electrically paralleled or interconnected with each other. Also referred to as a "break-before-make" transfer switch or scheme. An Open Transition transfer results in a momentary loss of power to the load from the two sources during the transfer (an Uninterruptible Power Source is sometimes used to prevent loss of power to the load or part of the load).

OSHA: Occupational Safety and Health Administration. See www.osha.gov.

Parallel System: A GF that can be electrically interconnected to a bus common with the Utility's electric power system, and can operate in electrical parallel either on a momentary or continuous basis.

Partial Requirements Service: Electric service provided to a Customer that has on-site interconnected generation whereby the output from its electric Generator(s) first supplies its own electric load requirements with any excess generation (over and above Customers own load requirements at any point in time) then being back-fed into the APS System. APS supplies any supplemental electric load requirements of Customer (those not met by Customer's own generation).

Potential Open Point: For the purpose of this document, a Potential Open Point constitutes any circuit breaker, contactor, switch or similar device that can be opened and/or closed, and which is not equipped with either a sync check or synchronizing function.

Production Meter: An APS-owned electric meter installed at a GF and configured so as to record or allow calculated energy output of the GF. The Production Meter will be an AMI type, unless otherwise specified by APS.

Point of Interconnection (POI): The physical location where APS's service conductors are connected to a Customer's conductors, bus, and/or service equipment to allow parallel operation of Customer's GF with the APS System. Also referred to as the Point of Common Coupling (POCC).

Power Control System (PCS): A control system that resides within the GF that manages output from one or more DERs based on one or more current sensors situated at locations that may be remote from the generation devices. The PCS shall be listed to UL 1741 CRD and shall have the capability of controlling the charging and discharging of any/all connected Energy Storage.

Qualifying Facility (QF): Any Cogeneration or Small Power Production Facility that meets the criteria for size, fuel use, efficiency, and ownership as promulgated in 18 CFR, Chapter I, Part 292, and Subpart B of the FERC's Regulations.

Radial Line: A distribution line that originates from a substation and is normally not connected to another substation or another circuit sharing the common supply of electric power.

Readily Accessible: Capable of being reached quickly and conveniently on a 24-hour basis without requiring climbing over or removing obstacles, obtaining special permission, keys or security clearances.

Reclosing: The act of automatically re-energizing a utility power line in an attempt to restore power following a fault on the line.

Relay: An electric device that is designed to interpret input conditions in a prescribed manner and after specified conditions are met to respond to cause contact operation or similar abrupt change in associated electric control circuits.

Retail-Scale Distributed Energy Resources (R-DER): DER that offsets customer load. These DER include residential, commercial, and industrial Customers. Typically, the residential units are single-phase while the commercial and industrial units can be single- or three-phase facilities.

Rotating Machine (also referred to as a Rotating Generator): An induction or synchronous machine (or machines) used to generate alternating current (AC) electric power.

Separate System: The operation of a GF that has no possibility of operating in parallel with, or potentially Backfeeding onto, the APS System.

Service Entrance Section (SES): The Customer-owned main electrical panel or equipment located at its premises to which the Utility delivers electric energy via the Utility service drop or service lateral.

Site Inspection (or APS Site Inspection): Verification performed by an APS qualified representative (inspector) prior to granting permission to parallel/operate a GF if deemed necessary by APS. The inspection may include, but not limited to, verification that the GF is in compliance with the NEC as adopted by the local AHJ, meets all APS ESRM and Interconnection requirements, and other applicable local and/or national safety codes.

Small Power Production Facility: A facility that uses primarily biomass, waste or renewable resources, including wind, solar, and water to produce electric power.

Smooth Parallel Transition: A form of Closed Transition Transfer in which the transfer of electrical load between two power sources occurs by electrically synchronizing and paralleling the power sources for a period of time in order to effect a smooth loading (sometimes referred to as soft loading) or unloading of the respective power source. A Smooth Parallel Transition is normally accomplished by paralleling the power sources for a period of 5 to 10 seconds.

Source Device: An electrical device (e.g., switching cabinet, primary transition, or primary metering device) which is directly powered by an APS Distribution System circuit or feeder at distribution level voltage (21 kV or less).

Source Transfer Equipment: Equipment specifically designed and installed to transfer electrical load between two separate power sources. Such equipment may consist of either a Transfer Switch which must be tested and certified to UL 1008/1008A, or a custom engineered Transfer Scheme which is not listed to UL 1008/1008A. The load transfer may be accomplished either via an Open Transition Transfer or via a Closed Transition Transfer.

Static Inverter: An electronic device (or devices) used to convert direct current (DC) power into alternating current AC power.

System Impact Study (~~SiS~~SIS) – A full technical review of the project's impact on the reliability of the APS power delivery system, including a load flow study, short-circuit study, circuit protection and coordination study, impact on system operation, stability study, and voltage collapse study. Additionally, this study will determine if any upgrades to APS's system are required to build and interconnect the project as designed.

Tap: The beginning connection point of Tap Conductors as defined by NEC Article 240.2.

Tap Conductors: Conductors that, other than service conductors, have overcurrent protection ahead of its point of supply that exceeds the value permitted for similar conductors that are protected as described elsewhere in NEC Article 240.4.

Third-Party Inspection: An inspection performed by a recognized, qualified organization or individual, that examines and/or evaluates the safety, integrity, workmanship, and installation of electrical equipment installed as part of a Generating Facility.

Totalized Metering: The measurement for billing purposes on the appropriate rate, through one meter, of the simultaneous demands and energy consumption of a Customer who receives electric service at more than one SES at a single site in accordance with APS Service Schedule 4.

Transfer Scheme: Source Transfer Equipment, which is specifically engineered and custom designed for the purpose of transferring electrical load from one power source to another. Transfer Schemes are generally not tested to UL 1008/1008A.

Transfer Switch: Source Transfer Equipment, which may be designed to be automatically or manually operated for the purpose of transferring electrical load from one power source to another. Transfer Switches must be certified and tested to UL 1008/1008A.

Transfer Trip Scheme: A form of remote trip in which a communication channel is used to transmit a trip signal from the relay location (e.g., utility substation) to a remote location (e.g., GF).

Transmission System: Utility-owned high-voltage lines (69 kV or higher) and associated equipment for the movement or transfer of electric energy between power plants and the Distribution System.

UL: Underwriters Laboratories Inc. See www.ul.com.

UL Listed: Equipment identified herein that is required to be tested and certified to an applicable UL Standard and which shall also be listed and labeled according to Section 110.3 of the NEC.

UL 98: UL Standard for Enclosed and Dead-Front Switches.

UL 1008: UL Standard for Transfer Switch Equipment.

UL 1008A: UL Standard for Medium Voltage Transfer Switches.

UL 1642: UL Standard for Lithium Batteries.

UL 1703: UL Standard for Flat-Plate Photovoltaic Modules and Panels.

UL 1741: UL Standard for ~~Inverters, Converters, Controllers and Interconnection System Equipment for Use with Distributed Energy Resources.~~

~~**UL 1741 SA:** UL Standard Supplement A for Advanced~~Safety – Inverters, Converters, Controllers and Interconnection System Equipment for Use with Distributed Energy Resources.

UL 1741 SA: UL 1741 Standard Supplement SA – Grid Support Utility Interactive Equipment.

UL 1741 SB: UL 1741 Standard Supplement SB – Grid Support Utility-Interactive Inverters and Converters Based on IEEE 1547-2018 and IEEE 1547.1-2020.

UL 1973: UL Standard for Batteries for Use in Light Electric Rail (LER) Applications and Stationary Applications.

UL 9540: UL Standard for Energy Storage Systems and Equipment.

Utility: The electric power company (in this case APS) that constructs, operates, and maintains its electrical power system for the receipt and/or delivery of electric power.

Utility-Scale Distributed Energy Resources (U-DER): DER directly connected to the distribution bus or connected to the distribution bus through a dedicated, non-load serving feeder (i.e., Dedicated Utility Feeder). These resources are specifically three-phase interconnections, and can range in capacity, for example, from 0.5 to 20 MW although facility ratings can differ.

Utility System: See APS System.

Utility-Grade Relays: Relays specifically designed to protect and control electric power apparatus, tested in accordance with the following ANSI/IEEE standards:

(1) ANSI/IEEE C37.90-~~1989 (R1994~~2005 (R2011), IEEE Standard for Relays and Relay Systems Associated with Electric Power Apparatus.

(2) ANSI/IEEE C37.~~9.01-1989 (R1994),~~90.1-2012, IEEE Standard Surge Withstand (SWC) Tests for Protective Relays and Relay Systems.

(3) ANSI/IEEE C37.90.2-~~1995,~~2004 (R2010), IEEE Standard Withstand Capability of Relay Systems to Radiated Electromagnetic Interference from Transceivers.

WECC: Western Electricity Coordinating Council. See www.wecc.org.

Wholesale Generation: A GF connected directly to the APS System that sells energy and capacity directly to a ~~utility~~Utility under a power purchase contract.

3 APS POLICY ON CUSTOMER-OWNED GENERATION

Any Customer qualifying as a QF under the Public Utility Regulatory Policies Act (PURPA) of 1978 may operate its GF in parallel with the APS System provided Customer GF will:

1. not present any hazards to APS personnel, other Customers or the public,
2. minimize the possibility of damage to APS and other Customer equipment,
3. not adversely affect the quality of service to other Customers, and
4. not hamper efforts to restore a feeder to service (specifically when a Clearance is required).

   NOTE: Customer will pay all costs to interconnect their respective GF to the APS System. Costs shall include any/all system upgrades and costs of furnishing and constructing any/all interconnection facilities.

Customer must also comply with all of the following prior to paralleling a GF with APS:

1. The GF must meet all the interconnection, safety, and protection requirements outlined in this document or as otherwise ~~determined by~~agreed upon between the Customer and APS.
2. Customer must sign an Interconnection Agreement, as well as an Electric Supply/Purchase Agreement, as applicable, with APS.
3. Customer must comply with and is subject to all applicable service and rate schedules and requirements, ACC Interconnection Rules, fees, rate tariffs and other applicable requirements as filed with and approved by the Arizona Corporation Commission, and as otherwise referenced in this document.

   ~~NOTE: If a conflict between ACC Interconnection Rules and the APS Interconnection Requirements exists, the APS Interconnection Requirements shall govern as permitted by ACC Interconnection Rules, A.A.C. R14-2-2614(E).~~
4. At APS's option, the GF may be inspected by APS personnel.
5. Written permission to parallel/operate must be obtained from APS.

   NOTE: When APS issues a permission to parallel/operate letter to Customer, the letter does not relieve Customer of the responsibility of full compliance with the APS Interconnection Requirements and all applicable building and safety codes, and local permitting requirements.

It is APS policy to permit Customer generating equipment with an aggregate generation AC output nominal ~~AC~~ nameplate rating of less than 1 MW that is not qualified as a QF under PURPA to operate in parallel with the APS System, provided ~~that~~ all ~~of~~ the conditions outlined above are complied with and Customer does not fall under FERC jurisdiction.

~~APS~~As required by FERC, APS must requires any GF (other than a Backup Generator), that is not owned by APS, interconnecting with the APS System, with an aggregate generation AC output nominal ~~AC~~ nameplate rating of greater than 1 MW to provide documentation acceptable to APS (including FERC Form 556), that confirms the GF has achieved QF status under 18 CFR, Chapter

1, Part 292, Subpart B, including, without limitation, §292.207 of the FERC's regulations, as amended. This self-certification as a QF will be required regardless of the voltage at the POI.

Exception: Self-certification requirement above is waived for GFs that are: 1) installed in Behind the Meter/R-DER installations, and 2) not expected to ever produce more energy from the GF than is consumed by the host Customer's facility on any 12-month calendar basis.

The links to FERC for "Frequently Asked Questions" and "Form 556" are listed below:

~~www.ferc.gov/ferc-online/frequently-asked-questions-faqs-efilingferc-online~~

~~www.ferc.gov/electric/general-information/electric-industry-forms#~~

www.ferc.gov/about/what-ferc/frequently-asked-questions-faqs/qualifying-facilities-qf-faq

www.ferc.gov/industries-data/electric/resources/industry-forms/form-no-556-certification-qf-status-small-power

To be considered NON-FERC, the proposed GF (greater than 1 MW):

1. Must be a QF and must self-certify with FERC guidelines (refer to Section 3 of this document).
   Exception: Behind the Meter/R-DER projects are not required to self-certify as a QF.
2. May not exceed ~~instantaneously delivery of~~ 80 MW of generation ~~to the APS System~~capacity.
3. APS shall be the off-taker of 100% of all produced generation.
4. Is voltage class agnostic (below 69 kV).
   ~~*Exception: Any APS-owned GF at 69 kV and higher could be considered to FERC as the generation output would be available for interstate sales.*~~

   NOTE: If at any time the QF changes any of the above conditions, it will need to be re-evaluated by APS for applicability. Customer shall notify APS and reapply if any of the above conditions change.

Due to relay coordination and potential Backfeed problems, APS cannot permit any DG with an AC nameplate output rating of greater than 10 kW to be connected to a Primary or Secondary Network System, or to a Customer SES electrically fed via an APS-owned distribution feeder Automatic Transfer Switch (ATS) without a detailed Interconnection Study being undertaken at Customer's expense to determine, among other things, special relaying, communication channels and other operational constraints that need to be implemented. A DG connected to either a Primary or Secondary Spot Network system will nonetheless not be permitted to Backfeed any power into the APS System.

The minimum protective and safety devices (relays, circuit breakers, ~~disconnect switches~~disconnects, etc.) specified must be installed and placed into service before allowing parallel operation of Customer's GF with the APS System. These devices isolate Customer's generating equipment from the APS System whenever faults, over-current conditions, or disturbances occur, as well as for maintenance purposes. Modifications to the APS electrical

system configuration or protective equipment may also be required at the expense of Customer in order to accommodate parallel generation.

APS will not assume any responsibility for the protection of Customer's generator(s), or of any other portion of Customer's electrical equipment. Customer is fully and solely responsible for protecting its equipment in a manner to prevent any faults or other disturbances from damaging, or otherwise adversely affecting, the operation of Customer's equipment.

In addition to complying with all required codes, ordinances and statutes, Customer must obtain an electrical permit and inspection indicating that Customer's GF complies with the NEC, as adopted by the AHJ. In the event that a Customer's GF is located in a locality where there is no AHJ, or the AHJ does not issue a permit or perform an inspection of the GF, then Customer will be required to sign a "Letter-in-Lieu of Electrical Clearance." APS will forward this letter for Customer's notarized signature.

APS can disallow the interconnection of a Customer's GF if, upon review of Customer's design, or as the result of a Site Inspection, it determines that the proposed design is not in compliance with applicable safety codes, as it could constitute a potentially unsafe or hazardous condition.

If APS believes that there may be a potential safety issue or code violation, then APS reserves the right to forward the GF diagrams to, and/or discuss same with, the AHJ.

4 DISTRIBUTED GENERATION TYPES

Distributed generators include induction and synchronous electrical generators as well as any type of Static Inverter capable of producing AC power. A **Separate System** is one so designed that the generation never interconnects (operates in electrical parallel) with, or is capable of ever Backfeeding, the APS System. A **Parallel System** is one where a Generator can electrically parallel, or has the potential to be paralleled, with the APS System. Such parallel operation may be performed either on a momentary or on a continuous basis. Note that Backup Generators as defined in Section 2 of this document are not subject to ACC Interconnection Rules.

Customer may elect to configure its Generator as a Separate System with open transition transfer of load between two independent power systems as described in Section 4.1, or Customer may configure its Generator to run in parallel with the APS System as is described in Section 4.2.

4.1 Separate System

A Separate System is one in which there is no possibility of electrically connecting or paralleling a Backup Generator with the Utility System, or of a Backup Generator otherwise posing a potential risk of Backfeeding the Utility System. Load must be transferred between the two power systems by utilizing a Transfer Switch specifically designed to operate in an Open Transition Transfer mode. The Transfer Switch must always disconnect the load from the APS System prior to connecting it to the Generator. Conversely, the Transfer Switch must also disconnect the load from the Generator prior to re-connecting it with the APS System. These requirements apply to both actual emergency operations as well as to testing the Generator.

The Transfer Switch shall satisfy either one of the following design conditions:

(1) It must be tested and certified to UL 1008 (or UL 1008A), and/or

(2) It must be a true double-throw, fail-safe mechanical throw-over design which inherently precludes any possibility of the Utility and Generator sources from ever being connected together, even in the event of a switch failure such as welded contacts at one of the power source switch contacts. Note that a Transfer Switch or Transfer Scheme comprised of two interlocked electrical breakers or contactors will not meet this requirement, irrespective of how they may be interlocked. The Transfer Switch, for the purpose of qualifying as a Separate System as outlined in this Section, shall be of the manually operated type, and shall be tested and certified to UL 98.

In addition to meeting either of the design conditions specified above, the Transfer Switch installation shall also meet the following requirements in order to qualify as a Separate System:

(1) The Transfer Switch must be a permanent installation in the facility and must be inspected by the AHJ.

(2) The normal source (utility) electrical conductors and the emergency (generator) electrical conductors feeding the Transfer Switch shall not be routed in the same conduit or raceway or in any way share a common enclosure except inside the approved Transfer Switch.

An Open Transition Transfer Switch or Scheme that does not satisfy the requirements for a Separate System as outlined above constitutes a potential Backfeed source to the APS System. As such, APS has certain requirements that must be adhered to. These are described in Section 13 of this document. Also, refer to Section 104.11 of the APS ESRM for further details.

If Customer claims a Separate System, Customer shall submit an Application along with associated Supplementary Information for APS review and acceptance. Refer to the Appendix A and the APS Interconnection Application Process Guide available at www.aps.com/dg for additional details.

NOTE: Portable generators are normally not designed to be connected to a building's permanent wiring system, and are not to be connected to any such wiring unless approved Source Transfer Equipment is used and the installation is inspected by the AHJ. Opening a source circuit breaker or disconnect ~~switch~~ (such as the main breaker in an SES) in order to connect a portable generator is prohibited. Failure to use approved Source Transfer Equipment can result in Backfeed into the APS System – the generator voltage can be stepped up to a very high voltage through the APS transformer. This can pose a potentially fatal shock hazard to anyone working on the Utility power lines or equipment.

4.2 Parallel System

In a Parallel System, a Generator is connected to a bus common with the APS System, and a transfer of power between the two systems is a direct result. A consequence of such interconnected operation is that Customer's Generator must be considered in the electrical protection and operation of the APS System.

A Parallel System encompasses any type of Generator or GF (including ES systems) that can electrically parallel with, or potentially Backfeed the APS System. This includes any GF using a Closed Transition Transfer Switch or Transfer Scheme as well as any Static Inverter that can be configured or programmed to operate in a "utility interactive" mode.

The ACC Interconnection Rules, A.A.C. R14-2-2603, designate two system configurations for operation in parallel with the APS System:

1. Exporting System
2. Inadvertent Export System

APS has specific interconnection, inspection and contractual requirements, as outlined in this document that must be complied with and information that needs to be submitted for all interconnected generators. These requirements include a "visible open" Utility Disconnect ~~Switch~~ meeting certain requirements to isolate Customer's System from the APS System, as well as protective relaying, metering, special rate schedules, and other safety and information requirements. Customer will be responsible for having the GF protective schemes tested by a qualified testing/calibration company. APS personnel will inspect the system and Customer will be required to sign an Interconnection Agreement and, if applicable, an Electric Supply/Purchase Agreement with APS.

In certain instances, APS and Customer will need to sign a ~~"~~Non-Parallel Connection Agreement~~"~~ and/or an ~~"~~Operating Agreement~~."~~. APS will advise Customer of requirements after reviewing the proposed design.

NOTE: A ~~"~~Non-Parallel Connection Agreement~~"~~ will be required for GFs declared as ~~"~~Non-Exporting Systems~~"~~ as described in A.A.C. R14-2-2603 of the ACC Interconnection Rules. Such GFs have the capability, but will not operate in electrical parallel with the APS System, and will not require a Production Meter as noted in Section 9 of this document.

APS does not extend "blanket approval" to any specific type of Generator or generation scheme since each project is site specific and needs to be reviewed on a case-by-case basis.

In addition to the various other requirements specified in this document, ~~Parallel Systems~~parallel systems shall specifically comply with the technical requirements outlined in the ~~Interconnection Technical Requirements~~interconnection technical requirements (Section 8) of this document.

5 CUSTOMER RESPONSIBILITIES

5.1 Facilities and Costs

The Customer is responsible for all facilities required to be installed solely to interconnect the Customer's GF to the APS System. This includes connection, transformation, switching, protective relaying, metering and safety equipment, including a ~~visibly~~visible open Utility Disconnect ~~Switch~~ and any other requirements as outlined in this document, the ESRM and applicable rate schedules as well as any other special items specified by APS. All such Customer facilities are to be installed by the Customer at the Customer's sole expense. In the event that additional facilities are required to be installed on the APS System to accommodate the Customer's generation, APS will install such facilities at the Customer's expense. APS may also charge the Customer for any administrative costs and/or the costs of studies required to interconnect the Customer's generation.

5.2 Ownership

Customer will own and be responsible for designing, installing, operating, and maintaining:

(A) The GF in accordance with the requirements of all applicable electric codes, laws and governmental agencies having jurisdiction.

(B) Control and protective devices, in addition to minimum protective relays and devices specified in this document, to protect its facilities from abnormal operating conditions such as, but not limited to, electric overloading, abnormal voltages, and fault currents. Such protective devices must promptly disconnect the GF from APS's System in the event of a power outage on the APS System. (See APS Service Schedule 2.)

(C) Interconnection facilities on Customer's premises that may be required to deliver power from Customer's GF to the APS System at the POI.

5.3 Insurance

(A) Recommendation

Due to risks associated with interconnecting and operating a GF with the APS System, such as serious bodily injury, death, or property damage, it is recommended that every Customer protect itself with insurance or other suitable financial instrument sufficient to meet its construction, operating and liability responsibilities. A Customer should consult with its insurance advisor to determine what issues may be posed by the installation of the GF, since current policies may not have contemplated its addition, and changes may need to be made to the existing insurance policy to include coverage of the GF itself and the consequences of its operation. APS does not require that the Customer negotiate any policy or renewal of any policy covering any liability through a particular insurance provider, agent, solicitor, or broker.

(B) Requirement

Unless directed otherwise by APS, any Customer operating a Rotating Machine(s) with an aggregate ~~nominal~~ AC output nominal nameplate rating of greater than 50 kW shall, at its own expense, maintain in force general liability insurance with a limit of $1,000,000 per occurrence and an umbrella or excess liability insurance policy with a limit of no less than $10,000,000 per occurrence. The insurance policies shall name APS as additional

insured and shall not contain any exclusion for liabilities related to the interconnection undertaken pursuant to the Interconnection Agreement. The amount of insurance shall be sufficient to insure against all reasonably foreseeable direct liabilities given the size and nature of the GF being interconnected, the interconnection itself, and the characteristics of the system to which the interconnection is made. Customer shall be required to obtain additional insurance, only if necessary, as a function of owning and operating a GF. Insurance shall be obtained from an insurance provider authorized to do business in Arizona. Certification that insurance is in effect shall be provided upon APS's request, except that Customer must show proof of the insurance to APS no later than ten (10) business days prior to the date upon which the GF commences interconnected operation with the APS System. If Customer is determined by APS to be of sufficient creditworthiness, Customer may propose to self-insure for liabilities.

5.4 Agreements

Interconnected Customers shall be required to sign an Interconnection Agreement in addition to any other agreements that may be applicable.

Customers that connect a backup or emergency generator with an open transition transfer scheme shall be required to sign a Non-Parallel Connection Agreement with APS. Unlike a UL 1008 transfer switch, a transfer scheme does not satisfy the requirements for a Separate System as outlined in Section 4.1.

Customers that connect a static inverter to the ~~utility~~Utility, and which will be programmed so as not to Backfeed into the Utility System (i.e., non-utility interactive mode), will need to sign a Non-Parallel Connection Agreement with APS, since such an arrangement can constitute a potential Backfeed source.

Customers that purchase power from, or sell power to, APS may be required to sign an Electric Supply/Purchase Agreement.

Customers that connect at primary service (**above 600Vac Utility service**) will need to sign an Operating Agreement with APS.

In the event Customer wishes to modify, reduce, expand and/or add to an existing Interconnected GF (e.g., addition of a grid interactive battery backup system), the Customer shall submit a new Interconnection Application and associated diagrams in accordance with Section 16 of this document. ~~Modifying GF AC system output (kW) that does not involve the modification of any installed equipment (i.e., power limiting) will require notification to APS, and may require secondary nameplate/placards be installed to alert the Customer, their contractors and APS personnel working on the equipment in the future.~~

5.5 Multiple Services

In the event that Customer's facility is fed by more than one APS electrical service, Customer shall:

(A) Have controls and operating procedures that are acceptable to APS to ensure that services will never be paralleled; and

(B) Ensure that the GF is never connected to an electrical service other than the one specified in Customer's Interconnection Application and/or Interconnection Agreement.

Additional information is given in Section 104.12 “Protection and Isolation Requirements for Multiple Utility Services to a Customer Facility” of the APS ESRM.

6 MUTUAL UNDERSTANDINGS

6.1 Interconnections

APS will not install or maintain any lines or equipment on a Customer's side of the POI, except it may install electric meters and at times research equipment. Only authorized APS employees (with credentials to identify their company affiliation) may make and energize the service connection between the APS System and Customer's service entrance conductors.

6.2 Easements and Rights of Way

Where an easement or right of way is required to accommodate the interconnection, Customer must provide to APS suitable easements or rights of way, in APS's name, on the premises owned, leased, or otherwise controlled by Customer. If the required easement or right of way is on another's property, Customer must obtain and provide to APS a suitable easement or right of way in APS's name, at Customer's sole cost and in sufficient time to meet the ~~Interconnect~~Interconnection Agreement requirements. All easements or rights of way must be on terms and conditions acceptable to APS.

6.3 Rate Schedules

The rate applicable to the interconnection of a Customer's GF will depend on the system size, type and configuration. Refer to Section 10 of this document for the rate schedules applicable to Distributed Generation. Because of varied and diverse requirements and operating modes associated with the interconnection, Customer must evaluate and determine which system configuration and electric rate is most appropriate and if it qualifies for the particular rate. Customer remains fully responsible for such matters; APS assistance or information should not be taken as constituting any representation or warranty about any particular option.

Any energy purchases from Customer's facility will be in accordance with the rate schedule and/or an Electric Supply/Purchase Agreement, any changes required by law or regulation, and rates authorized by law. GFs with requirements of unusual size or characteristics may require special rate and contract arrangements.

~~APS will not be obligated to buy energy or capacity from a Customer if the purchase would result in greater cost to APS than if APS generated the energy itself or purchased it from another source. APS will give reasonable notice so that Customer may discontinue deliveries to APS or may opt to sell energy to APS at a lower rate.~~

6.4 ACC Jurisdiction

The rates, terms or other contract provisions governing the electric power sold to a Customer by APS, purchased from Customer by APS, and Interconnection of DG by Customer with the APS System as noted within ACC Interconnection Rules, A.A.C. R14-2-2602 are subject to the jurisdiction of the ACC. APS retains at all times and without restriction the right to file a unilateral ACC application for a change in requirements, charges, classification, or service, or any rule, regulation or agreement as allowed by law.

7 DESIGN CONSIDERATIONS AND DEFINITION OF CLASSES*RESERVED*

Protection requirements are influenced by the size and characteristics of the parallel generator along with the nature and operational characteristics of the associated APS System. Therefore, similar units connected to different lines could have different protection requirements based on varying load conditions, as well as on utility feeder and transformer characteristics.

7.1(A) Synchronous Units

Synchronous generators are generally capable of supplying sustained current for faults on the APS System. These units can also supply isolated APS load providing the load is within the units' output capability.

Reclosing of the Utility power source onto synchronous units must be blocked to prevent out-of-sync paralleling and must also be prevented from energizing a de-energized Utility line. Automatic reclosing by APS is time-delayed which allows for automatic Customer Generator separation prior to re-energization of the Utility source.

7.2(A) Induction Units

Induction generators are basically induction motors that are mechanically driven above synchronous speed to produce electric power. These units do not have a separate excitation system and, as such, require that their output terminals be energized with AC voltage and supplied with reactive power to develop the magnetic flux. Induction generators are therefore normally not capable of supplying sustained fault current into faults on the Utility System. Such units are generally not capable of supplying isolated load when separated from the Utility System; however, it is possible for an induction generator to become self-excited if a sufficient amount of capacitance exists at its output terminals.

Under conditions of self-excitation, an induction generator will be capable of supplying isolated load, providing the load is within the units' output capability. In most cases when self-excitation occurs, it will be accompanied by a sudden increase in terminal voltage. APS and its other Customers must be protected from out-of-phase closing and over-voltages that can occur whenever an induction generator becomes self-excited. Induction units must therefore be designed to automatically separate from the Utility System upon loss of utility voltage and prior to reclosing of the utility feeder.

7.3(A) Static Inverters

Static inverters convert DC power to AC by means of electronic switching. Switching can be controlled by the AC voltage of the utility's supply system (line-commutated) or by internal electronic circuitry (forced-commutated).

Line-commutated inverters are generally not capable of operating independently of the utility's AC supply system, cannot normally supply any appreciable fault current, or continue to energize isolated loads provided proper protective functions are in place. To accommodate such protective functions, any line-commutated inverter that is electrically paralleled with the APS System shall be tested and certified to UL Standard for Inverters,

~~Converters and Controllers for use in Independent Power Systems, UL 1741/1741 SA by a NRTL certified by OSHA to perform the UL 1741/1741 SA test standard.~~

~~Forced-commutated, or self-commutated, inverters are capable of energizing load independently of the Utility System. Any forced-commutated inverter, the output of which is to be directly interconnected with the utility, needs to be specifically designed for that purpose. It would need to be designed to accommodate parallel interfacing and operation. However, it is not anticipated at this time that any forced-commutated inverters will be interconnected to the Utility System. APS would consider this type of interconnection on a case-by-case basis. Under no circumstance shall the self-commutated output of a "battery backup" type inverter, which is normally designed to energize a subpanel independently of the utility, be connected to the Utility System.~~

~~7.4(A) Definition of Generator Size Classes~~

~~The following generator size classifications are used in determining specific minimum protective requirements for distributed GFs. Specified ratings are for each connection to the APS System. Customers must satisfy, in addition to the general requirements specified in this document, the minimum relaying requirements given in this document (Section 8.7) for each generator class.~~

~~Class I — 50 kW or less, single or three phase~~

~~Class II — 51 kW to 300 kW, three phase~~

~~Class III — 301 kW to 5,000 kW, three phase~~

~~Class IV — over 5,000 kW, three phase~~

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8 INTERCONNECTION TECHNICAL REQUIREMENTS

The requirements and specifications outlined in this Section are applicable to DG interconnected for parallel operation (continuous or momentarily) with the APS System, unless otherwise specified. The protection and safety devices and other requirements specified in this Section are intended to provide protection for the APS System and its workers, other APS Customers, and the general public. They are not intended to provide protection for Customer's generation equipment or personnel. This is the sole responsibility of Customer.

With respect to protection objectives, it is necessary to disconnect a Generator operating in parallel with the APS System when trouble occurs. This is to:

~~(1)~~1. ensure if a fault on the APS System persists, the fault current supplied by Customer's Generator(s) is interrupted;
~~(2)~~2. prevent the possibility of reclosing into an out-of-sync isolated (islanded) system composed of the APS System, or a section thereof, and Customer's Generator(s);
~~(3)~~3. prevent reclosing the ~~Utility~~utility source onto Customer's GF that may be out of synchronism or stalled;
~~(4)~~4. prevent unintentional islanding.

The protection requirements are minimal for smaller installations, but increase as the size of Customer's generation increases. Small installations usually ensure that the Generator is small compared with the magnitude of any load with which it might become isolated. Thus, for any fault on the Utility System, ~~Utility~~utility protective devices will operate and normally isolate the generation with a large amount of load, causing voltage collapse and automatic shutdown of the Generator.

Section 11, Additional Requirements for GFs with an Aggregate AC Generation ≥ 1 MW, contains requirements that apply to any GF that is nominally rated to generate 1 MW or more and is interconnected with the APS System for continuous parallel operation.

For larger installations, the probability of isolated operation is higher since the available generation may be sufficient to carry the entire load, or part thereof, of the local APS circuit. In instances where the APS System arrangement is that it is possible that the generators will not always be isolated with comparatively large amounts of load, additional protection and generator shutdown schemes are required.

Customer is solely responsible for the protection of its equipment from automatic reclosing by the Utility. APS normally applies automatic reclosing to overhead electric distribution circuits. When the APS source breaker trips, Customer must ensure that its generator is disconnected from the Utility circuit prior to automatic reclosing by the Utility. The automatic reclosing on APS distribution feeders is normally delayed by at least 2 seconds. Automatic reclosing out-of-sync with Customer's Generator may cause severe damage to Customer equipment and could also pose a serious hazard to Customer or Utility personnel.

8.1 General Technical Requirements

(A) Compliance

Customer is responsible for obtaining and maintaining all required permits and inspections indicating that Customer's GF complies with all applicable codes, ordinances and statutes relating to safety, construction and operation.

(B) Multiple Generators

Multiple Generator connections on the same Utility service are permitted subject to APS approval; however, a single Utility Disconnect ~~Switch~~ for the GF will generally be required (normally located at the SES~~).~~) unless agreed upon by the Customer and APS. If APS approves more than one Disconnect ~~Switch~~ behind a Utility ~~Service~~service, then the Disconnect ~~Switch~~ shall be labeled per Section 8.6(B).

(C) Transfer Trip

The study process may determine the need for transfer trip.

A transfer trip scheme, and in some instances~~,~~ a Dedicated Utility Feeder ~~will~~, shall be required at customer expense if the Generator or aggregate Generators:

(1) Are of sufficient size to carry the (minimum) load of APS's distribution feeder, or

(2) Size or physical feeder location could support an isolated (islanded) section of the feeder~~.~~

If a transfer trip is required, or Customer's aggregate generation is one MW or greater, a communication channel and telemetering will also be required. The transfer trip scheme shall utilize the GF main breaker. These will be at Customer's expense. Refer to Sections 11 & 16.7 for additional information. In such instances, APS will need to perform an Interconnection Study to determine required facilities.

(D) Potential Open Point

Whenever a Generator is configured to operate in electrical parallel with the Utility grid, Customer shall ensure that any Potential Open Point (Open Point) located in the circuit between the Generator output and the Utility service is suitably interlocked to preclude the possibility of a potential out-of-sync closure occurring between the power sources. A Potential Open Point includes any circuit breaker, contactor, switch, etc., that is capable of being opened and/or closed, and which is not equipped with either a sync check or synchronizing function. A Potential Open Point may be interlocked by installing either of the following:

(1) An electrical interlock consisting of a set of electrical contacts on the Open Point, which are directly wired to instantaneously trip open a circuit breaker in the circuit, which is equipped with either a sync check or synchronizing function, whenever the Open Point is opened. This breaker, upon opening, shall immediately break the electrical path between the power sources.

(2) A keyed or other suitable mechanical interlock that will prevent the Open Point from ever being opened unless a circuit breaker in the circuit, which is equipped with

either a sync check or synchronizing function, is first opened. This breaker, when opened, shall immediately break the electrical path between the power sources.

NOTE: An exception can be made to this requirement for a Generator with built in anti-islanding protection that cannot be easily bypassed, circumvented and/or disabled. Additionally, APS could consider an intertie relay as a means of meeting these requirements that would trip off the Generator breaker (or breakers) in the event a Potential Open Point was operated and/or a grid outage occurred.

(E) Production Metering

If APS is required to install electric meter(s) to record the output of Customers Generator(s), Customer shall ensure that the design is such that the meter(s) are located on the utility- side of any Generator breaker on a normally energized bus. Electronic meters are not designed to be de-energized for any length of time.

(F) Supply Side Connection

If a Generator is connected or tapped on the supply (utility) side of an SES service disconnecting means, as may be permitted by the NEC, the installation is subject to all applicable NEC requirements and/or requirements adopted by the AHJ. The Tap is on the load side of the APS billing meter and ahead of the main service disconnect(s) to ensure that the billing meter registers net energy flow. The required disconnecting means shall also be in accordance with the APS ESRM.

(1) A Supply Side Connection (SSC), also referred to as a Line Side Tap, constitutes a new service as defined by the NEC, and is subjected to all applicable NEC requirements and/or requirements adopted by the AHJ. In addition, any such connection must comply with the APS ESRM and Good Utility Practice. The required SSC service disconnecting means shall also be in accordance with the APS ESRM. Any SSC shall be made without any modifications to any factory installed and/or UL listed equipment or components, unless expressly authorized by the panel manufacturer and/or listing agency. It must be performed in strict accordance with the panel manufacturer's directions and specifications. In order for APS to approve aan SSC interconnection, the following are required:

a. Rigid Metal Conduit (RMC) shall be used between the SSC connection in the SES and an externally mounted (external to the SES) SSC fused service disconnect (SSC Service Disconnect).

b. The ampere rating of the conductor feeding an SSC Service Disconnect shall not be less than #2 AWG Cu or the ampere rating of the SSC Service Disconnect, whichever is larger, unless determined otherwise by APS. The minimum ampere rating of the SSC Service Disconnect shall be 60 A per NEC Art 230.79(D).

c. The SSC Service Disconnect shall be mounted "immediately adjacent" to the SES, 10 feet or less per NEC Art 705.31, located on the same wall. The circuit shall not be routed through any other enclosures (i.e., junction boxes and/or distribution panels) between the SES and the SSC Service Disconnect. Workspace and elevation shall be in accordance with Section 8.2(C) of this document. If it is necessary to go beyond the 10-foot maximum requirement,

there is an allowance under NEC Art 705.31 for current limited circuit breakers or cable limiters to be installed at the tap point.

d. A neutral to ground (N-G) bond must be re-established in the SSC Service Disconnect, and GEC installed. Note however, that if the SSC is made via a breaker or fused disconnect ~~switch~~ located within the SES (i.e., not an externally mounted service disconnect), then the existing N-G bond will suffice. The grounding electrode conductor must be connected to the neutral bus (not the ground bus) in the SSC Service Disconnect and existing SES per NEC Art 250.24(A)(1) and exhibits in the code handbook.

e. If panel manufacturer authorization is granted to perform ~~a~~an SSC, proof of such authorization and AHJ approval shall be provided to APS as part of the Interconnection Application process.

   i. No drilling, tapping or replacing of factory installed bus bars or conductors unless performed by the manufacturer or its designated representative. If the UL is voided the equipment must be replaced or a field evaluation is required*

   ii. If lugs are replaced to accommodate additional conductors, the panel manufacturer must specify a listed kit or provide written approval of the parts to be used. Appropriate torque specs shall also be provided.

   iii. When connecting to a field installed conductor a UL listed tap should be used. Breaking the conductor should be avoided – using a lay in lug is preferred. The connector's make and model number should be provided.

   iv. Fused and unfused conductors shall not occupy the same raceway unless they are isolated from each other via a firewall barrier in a manner acceptable to APS.

   v. Bonding jumpers per NEC Art 250.92(B) shall be installed around reducing washers and any eccentric or concentric fitting knockouts remaining.

   vi. **Exception:** If panel manufacturer does not grant permission and/or have a kit to perform the Tap required, a field evaluation is required in order to perform the SSC~~.~~*.

      ~~vi.~~• **Note:** In this case, the Customer shall provide APS the Letter of Compliance issued to the NRTL certified by OSHA to perform the evaluation (i.e., CSA, TUV, UL, etc.) as well as a photograph of the approval sticker affixed to the SES at the time the work is completed in the field. A full list of authorized NRTL program providers can be located at ~~www.osha.gov/dts/otpca/nrtl/nrtllist.html~~www.osha.gov/dts/otpca/nrtl/nrtllist.html.

f. Per NEC Art 225.32, the Service Disconnect shall be Readily Accessible.

g. Per NEC Art 240.24(B), all over-current devices protecting the conductors supplying the premises shall be Readily Accessible to the occupant.

(2) No Customer connections or equipment are permitted in the Utility sealed metering compartment or pull-section of the SES. Any SSC shall be made in either (a) the applicable Customer accessible section of the SES (e.g., large system switchgear) or (b) a field installed NEMA 3R rated gutter or tap box (applies to meter-main or main-lug-only), and a label shall be placed at the SES in accordance with Section 8 of this document. Exception: Interconnection equipment such as a utility or customer-owned Meter Socket Adapter (MSA) interconnecting power production or whole home electric isolation and (intentional or unintentional) islanding of a Generating Facility shall be allowed where that device does not impede access to the sealed meter socket compartment or pull section of the sealed compartment of the Service Entrance Section (SES). The MSA shall meet the established MSA guidelines published listed in section 8.1.h of this document.

(3) APS secondary electrical service conductors are not fused and can only be de-energized by APS personnel. Customer will need to contact APS to arrange for the electrical service to be de-energized prior to performing an SSC. Since APS will not re-energize the service following completion of the SSC unless an electrical clearance (green tag) has been issued by the AHJ, it is important that Customer coordinate this work very closely with APS and the AHJ. In an area where there is no plan review or permit requirement imposed by the AHJ, a Third-Party Inspection is required to be completed with any/all corrections addressed by Customer Representative. In addition, the final report will be submitted to APS upon request.

(4) The maximum output current nameplate rating of the Generator(s) shall not exceed the 100% continuous duty rating of the APS transformer or service run. Note that the ratings of the APS transformer and service run do not necessarily match the SES rating. APS will notify Customer if any APS equipment is over-dutied following APS review of the Interconnection Application. Any required equipment upgrades shall be performed at Customer's sole expense.

(G) Load Side Tap

A Load Side Tap constitutes a tap as defined in this document, and is subject to all applicable NEC requirements and/or requirements adopted by the Authority Having

Jurisdiction. In addition, the connections must comply with the APS ESRM and Good Utility Practice.

The following requirements were prepared for applications where a generator is tapped on the load side of the main service disconnect:

(1) The Tap originating from the SES shall terminate at an accessible and lockable overcurrent protective device in accordance with NEC Art 240.4.

(2) For Tap Conductors 10 ft. or less (distance between SES and first overcurrent device), conductors shall be sized per ~~2014~~ NEC Art 240.21(B)(1).

(3) For Tap Conductors 25 ft. or less (distance between SES and first overcurrent device), conductors shall be sized per ~~2014~~ NEC Art 240.21(B)(2).

(4) The Tap shall be made without altering any factory installed bus bars or conductors unless performed by the manufacturer or its designated representative.

   a. No drilling, tapping or replacing of factory installed bus bars or conductors unless performed by the manufacturer or its designated representative.

   b. Bonding jumpers per NEC Art 250.92(B) need to be installed around reducing washers and any eccentric or concentric fitting knockouts remaining.

   c. Insulation piercing and threaded lug type connectors are allowed as long as they are protected by overcurrent protection devices on both ends.

   d. If lugs are replaced to accommodate additional conductors, the panel manufacturer must specify a listed kit or give written approval of the parts to be used. Appropriate torque specs shall also be provided.

   e. When connecting to a field conductor a UL listed tap should be used. Breaking the conductor should be avoided – using a lay in lug is preferred. The connector's make and model number should be provided.

(5) Exception: If panel manufacturer does not grant permission and/or have a kit to perform the Tap required, a field evaluation is required in order to perform the tap connections. In this case, the Customer shall provide APS the Letter of Compliance issued to the NRTL certified by OSHA to perform the evaluation (i.e., CSA, TUV, UL, etc.) as well as a photograph of the approval sticker affixed to the SES at the time the work is completed in the field. A full list of authorized NRTL program providers can be located at www.osha.gov/dts/otpca/nrtl/nrtllist.html.Per NEC Art 225.32, the overcurrent protective device shall be Readily Accessible.

~~(5) Per NEC Art 225.32, the overcurrent protective device shall be Readily Accessible.~~

(6) Per NEC Art 240.24(B), all overcurrent devices protecting the conductors supplying the premises shall be readable accessible to the occupant.

(7) Per NEC Art 250.122(G), the equipment grounding conductor run with the tap conductors shall be sized per the SES Main overcurrent setting but shall not be required to be larger than the tap conductors.

NOTE: For a typical Load Side Tap installation, APS requires a two disconnect ~~switch~~ configuration. The first ~~switch~~disconnect is fused and constitutes the Customer Fused Disconnect ~~Switch~~ as required by the NEC. The second ~~switch~~disconnect is the ~~Photovoltaic System~~ Utility Disconnect ~~Switch~~ required by APS.

(H) Interconnection System Equipment

Interconnection equipment such as a utility or customer-owned Meter Socket Adapter (MSA) interconnecting power production or whole home electric isolation and (intentional or unintentional) islanding of a Generating Facility shall be allowed where that device does not impede access to the sealed meter socket compartment or pull section of the sealed compartment of the Service Entrance Section (SES). The MSA shall meet the requirements listed below:

Interconnection equipment, such as a utility- or customer-owned Meter Socket Adapter (MSA), which is used to interconnect power production, energy storage, or whole-home electric isolation and (intentional or unintentional) islanding of a Generating Facility, shall be allowed where that MSA device does not impede access to the sealed meter socket compartment or pull section of the sealed compartment of the Service Entrance Section (SES). The following requirements apply to the use of an MSA for interconnection:

(1) MSAs must be UL 414 certified, and rated adequately for the connected equipment.
(2) The MSA must be installed, either, by APS or by a certified licensed and qualified professional electric contractor with an active electrical contractor license, R-11 or CR-11, including any subcontractors.
(3) APS residential customers shall be eligible to install an MSA if all of the following requirements are met:
    a. A self-contained electric meter panel not exceeding a 200 amp rating, as determined by APS, and a single phase 120/240 volt electric service is installed.
    b. Subject to exceptions approved by APS, the main breaker and meter socket are contained in the same electrical panel.
    c. An electric meter panel that meets all APS requirements and passes an initial review before the installation. The panel must also pass an evaluation by APS personnel or an APS-approved contractor.
    d. The customer's solar generating system, including an energy storage system if installed, connected to the MSA shall have a rating consistent with the specified fault currents in Table 800.2 of the APS Electric Service Requirements Manual

(per NEC Art. 110.9 & 110.10). Additionally, the service disconnecting means of the MSA shall meet NEC Art. 230.79.

e. Any existing customer generation or energy storage sources on the property that are interconnected with the APS service are identified on the interconnection application and submitted drawings.

f. The local Authority Having Jurisdiction has issued a permit for the installation of your generation system (or energy storage system) and the supply (or line) side connection to the MSA.

g. All customer-owned electrical equipment, including MSAs, must satisfy the meter clearances specified in the APS Electric Service Requirements Manual.

h. As applicable for the purposes of carrying current back to the utility distribution system, the wire between the fused disconnect switch and the MSA must be insulated copper wire, sized at AWG 6 gauge, and rated for 90° C.

i. Bond an Equipment Grounding Conductor from the Disconnect Switch and connect to the Service Grounding System; typically, #6 AWG copper, bare.

For the avoidance of doubt, an MSA is not allowed to be installed on electric panels that:

- have deteriorated parts,
- are rated above 200 amps,
- do not meet the equipment clearances,
- are located on poles or inside cabinets,
- have an overhead to underground service adapter,
- are a stand-alone meter socket attached to a stem wall or uninstalled separate from a residential building or structure at which service is delivered, or
- where the MSA and/or wires cannot be routed and terminated appropriately.

(G)

~~(H)~~(I) Prior to Ordering Equipment

Customer is responsible for the design, installation, operation and maintenance of all equipment on Customer's side of the POI. It is strongly recommended that Customer submit specifications and detailed plans as specified in the Interconnection Application (refer to the APS Interconnection Application Process Guide available at ~~www.aps.com/dg~~www.aps.com/dg) for the installation to APS for review and written acceptance prior to ordering any equipment. Customer shall not energize or interconnect the distributed energy generation system until the Utility approves the application. See Arizona Revised Statute 44-1764 (Title 44 Section 11). Written acceptance by APS does not indicate acceptance by other authorities.

~~(I)~~(J) Conductors

While APS recommends the use of copper conductors, if Customer nonetheless elects to use aluminum conductors to connect any equipment either owned by, or placed under

operational jurisdiction of APS (GF metering, Utility Disconnect ~~Switch~~, etc.), then Customer must comply with the following requirements:

(1) An oxidation inhibitor must be applied to the cleaned aluminum conductor.

(2) A UL Listed 2-hole bolted lug, compression type terminal, must be used for the terminations of the aluminum conductors.

(3) Compression terminal shall clearly indicate the conductor and the die to be used on the crimping tool, and the connection shall be made in strict accordance with manufacturer specifications.

(4) Locations of aluminum conductors must be clearly identified on the Interconnection Application diagrams submitted to APS for review.

APS will not assume any responsibility for any maintenance or inspection of conductors within an APS sealed portion of the GF. It shall be the sole responsibility of Customer to schedule and arrange for any such inspection.

8.2 Utility Disconnect ~~Switch~~ (Disconnect)

Customer shall install and maintain a ~~visual~~ visible open, manually operated, load break disconnect ~~switch (Disconnect Switch)~~ that will completely open and isolate all ungrounded conductors of Customer's GF from the APS System. ~~–~~For multi-phase systems, the ~~switch~~disconnect shall be gang-operated.

The Disconnect ~~Switch~~ shall comply with the following additional requirements:

(A) ~~Visual~~Visible Open and Lockable Requirements

The Disconnect ~~Switch~~ shall be visible-open such that the ~~switch~~ blades, jaws and the air-gap between them shall all be clearly visible when ~~the switch is~~ in the "open" position and the front cover ~~of the switch box~~ is opened~~.~~, in accordance with NFPA-70E Section 120.5 Process for Establishing and Verifying an Electrically Safe Work Condition. It is not acceptable to have any of the "visible open" components obscured by a ~~switch~~ "dead front" or an arc-shield, etc. Only ~~switches~~disconnects specifically designed to provide a true "visible open" are acceptable.

The ~~switch~~disconnect handle shall be capable of being locked in the "open" position by a standard APS padlock with a 3/8" shank. The ~~switch~~ front cover shall be kept locked at all times in accordance with NEC ~~Art~~ 110.31(D) and OSHA 1910.303(h)(2)(v)(D). The front cover hasp shall be capable of accepting a 3/8" shank padlock, and shall not be field modified in any way.

If a second service disconnecting means is required to be installed as in the case of a SSC, the second service disconnect cover shall be locked closed with a customer provided lock. In the event Customer installs additional ~~disconnect switches~~disconnects which are separate from the APS required Utility Disconnect ~~Switch~~, the covers of any such shall be locked closed with a customer provided lock.

~~Switch~~Consult manufacturer representative for list of APS approved visible open disconnects.

(B) Disconnect Connection

The Disconnect ~~Switch~~ shall be connected so that the blades (and any fuses if present) are de-energized when the ~~switch~~disconnect is in the "open" position in accordance with OSHA 1926.405(C), NEC 404.6(C) and NFPA 70E. For example, the ~~switch~~ blades (load side) will be connected to the inverter side of a Static Inverter based circuit and the ~~switch~~ jaws (line side) to the utility source side.

The Disconnect ~~Switch~~ shall be located on the utility source side of any meter installed to measure the output of the GF Generator(s) (i.e., Production Meter).

(C) ~~Switch~~Disconnect Location

The Disconnect ~~Switch~~ shall be installed in a Readily Accessible location (easily accessed by APS on a 24-hour basis – refer to definition) so as to provide safe (no tripping hazards, domesticated animals or other obstructions, etc.) and easy, unrestricted and unimpeded access to APS personnel. It must be installed adjacent to the Customer's SES; however, subject to APS' express approval, it may be located in the immediate vicinity of the Customer's Generator, provided that ~~APS's~~APS' access to the Disconnect ~~Switch~~ is not impeded.

The Disconnect ~~Switch~~ shall be installed in accordance with all applicable NEC and APS requirements. It shall be located between 36" and 60" measured from final grade to the center of the ~~switch~~disconnect and include a minimum clear working space of 36" by 36" in front of the ~~switch~~disconnect. The required working space may be greater than 36" by 36" (e.g., NEC Article 110 requirements). The Disconnect ~~Switch~~ shall not be:

(1) located behind an electrically operated gate or door unless the electric operator is backed up by an uninterruptible power source to ensure that it can be operated in the event of a ~~utility~~Utility power outage.

(2) installed under a breezeway, patio, porch or any area that can be enclosed.

(3) installed behind a gate, fence, wall or other barrier.

(4) mounted to a non-permanent structure (including a masonry wall, fence, etc.) unless utilizing service support specifications as noted in Section 306.0 of the APS ESRM.

NOTE: APS may grant an exception to commercial Customers who locate equipment (i.e., APS Utility Disconnect ~~Switch~~) behind a locked door or gate as long as the equipment is installed in a safe location (no tripping hazards, domesticated animals or other obstructions, etc.). In this case, APS can provide a ~~lockbox~~lock box to be installed by the commercial Customer for APS to gain access to the Disconnect ~~Switch~~ or any other APS equipment. The ~~lockbox~~lock box needs to be installed within 36" of the door or gate, etc., and it shall be located no less than 36" above grade and no more than 60" above grade. Indoor equipment locations require access from the exterior of the building.

(D) Electrical Ratings

The Disconnect ~~Switch~~ must be rated for the voltage and current requirements of the Generating Facility, and must be listed and conform to all applicable UL, ANSI and IEEE standards. The ~~switch~~disconnect shall be rated to withstand the available fault duty current and shall not be fused, unless expressly agreed to by APS. (Reference NEC Art 110.9, NEC Art 110.10, OSHA 1910.303(b)(4) and OSHA 1910.303(b)(5)). In the case where Customer installs a fused ~~Disconnect Switch~~disconnect to limit the fault current a second unfused Disconnect ~~Switch~~ for APS use will need to be installed subject to Section 8.2(C) above. In instances where a visible-open ~~switch~~disconnect is not commercially available (e.g., due to a high system current), APS may accept a Customer installed rack-out breaker, along with a racking tool and grounding breaker (to ground the utility side) as may be required, in order to effect an electrical clearance or establish a safe working area. In these cases, APS will work with Customer to determine the best option and ensure that all appropriate safety requirements are met.

~~**Switch**~~

(E) Disconnect Grounding

The ~~switch~~disconnect enclosure shall be properly grounded via an equipment ground wire attached to a factory provided grounding lug or an appropriately UL listed grounding lug or terminal.

In cases where the Disconnect ~~Switch~~ will be installed on a line at a voltage above 600V, APS has specific grounding requirements that will need to be incorporated into the Disconnect ~~Switch~~ in order to ground the phase conductors on the utility side of the ~~switch~~disconnect when it is necessary to establish a safe working area for APS personnel. Refer to the APS ESRM for further details. APS also has certain requirements that will need to be adhered to for the purpose of obtaining electrical clearances or establishing a safe working area, including the entering into an ~~"~~Operating Agreement~~"~~ with Customer.

(F) ~~Switch~~Disconnect Conductors

The Disconnect ~~Switch~~ shall be a stand-alone device, and electrical conductors and/or cables entering into and exiting from the Disconnect ~~Switch~~ shall be kept physically separated and shall not be routed in the same raceway or in any way share a common enclosure.

Under no circumstances shall the Disconnect ~~Switch~~ enclosure be used as a conduit or raceway for any conductors other than those phase conductors being switched, the neutral (grounded conductor) and equipment ground (grounding conductor).

(G) Operational Jurisdiction

The Disconnect ~~Switch~~ will be placed under the operational jurisdiction of APS for systems with a line voltage of 600V or less, and the cover of such ~~switch~~disconnect will be locked closed with a standard 3/8" shank APS padlock following satisfactorily completion of the APS Site Inspection.

Under no circumstances shall the Disconnect be remotely operated or involved in protective schemes.

APS shall have the right to lock open, or cause to be locked open, the Disconnect ~~Switch~~ without notice to Customer when interconnected operation of the Customer's GF with the APS System could adversely affect the APS System or endanger life or property, or upon termination of the ~~Interconnect~~Interconnection Agreement.

(H) NEC Rapid Shutdown of Photovoltaic Systems

For systems to be equipped with rapid shutdown:

(1) The Utility Disconnect(s) shall not be designated as the rapid shutdown initiation device(s).
(2) Rapid shutdown initiation shall not depend on the Utility Disconnect(s).
(3) Install according to applicable NEC and AHJ requirements.

8.3 Dedicated Service Transformers

The additional installation of a dedicated service transformer would be included in the cost of Interconnection. Dedicated service transformers shall be configured grounded-wye on the utility/high voltage side. The high-side grounding shall be accomplished via the installation of a ground strap connected from the H0 bushing to the ground reference.

(A) Dedicated Secondary Transformer

~~8.3 Transformation~~

~~(A) Dedicated Secondary Transformer~~

~~A~~For secondary systems (600Vac Utility services and below), a GF may be required to be isolated from other Customers ~~feeding~~fed off the same utility transformer by a dedicated ~~power~~service transformer connecting to the utility distribution feeder. The primary purpose of the dedicated transformer is to ensure that (A) the generation cannot become isolated at the secondary voltage level with a small amount of other-Customer load, and (B) the generation does not contribute any significant fault current to other Customer's electrical systems. It also helps to confine any voltage fluctuation or

harmonics produced by the Generator to Customer's own system. ~~-~~APS will specify the transformer winding connections and any grounding requirements based on the specific Customer site location and generator type. This option is evaluated as part of the study process.

(B) Dedicated Primary Transformer

For primary systems ~~requiring step down transformation ((~~above 600Vac Utility service ~~-~~ i.e., multi megawatt power plants), ~~the~~ dedicated ~~primary transformer shall be configured grounded wye on the utility/high voltage side. The high side grounding shall be accomplished via the installation of a ground strap connected from the H0 bushing to the ground reference. Dedicated primary~~service transformer configurations as noted herein apply to all transformer bank skids. Any exceptions would be studied on a case-by-case basis.

8.4 Power Quality

In order to minimize interference on the Utility System Customer must ensure that the electrical characteristics of its load and generating equipment meet, as a minimum, the specifications outlined below.

~~**(A) Power Factor**~~

~~When the GF acts as a net load to the APS System, the power factor of the net load shall not be less than 90% lagging (absorbing vars) as measured at the POI, and shall not be leading (exporting vars), unless agreed to by APS.~~

~~When the GF acts as a generation source to the APS System, and the nominal AC output nominal rating is less than 10 MW the power factor of the generation source shall not be less than 90% leading (absorbing vars) as measured at the POI, and shall not be lagging (exporting vars), unless otherwise required by APS.~~

~~When the GF acts as a generation source to the APS System, and the nominal AC output nominal rating is 10 MW or greater the GF shall be capable of operating in any of the modes specified in Section 12.1 (Dynamic Response Requirements) of this document.~~

(A) ~~(B)~~ Current Imbalance

The phase current imbalance for a three-phase system as measured at Customer's SES shall not be greater than 10% at any time. For further information, refer to APS Service Schedule 1.

(B) ~~(C)~~ Harmonics

The electrical output of Customer's GF shall not contain harmonic content that may cause disturbances on or damage to the APS System, or other Customer's systems, not limited to computer, telephone, communication and other sensitive electronic or control systems. Harmonics, as measured at the POI, shall not exceed the limits promulgated in the latest version of IEEE 519.

(C) ~~(D)~~ Power Fluctuations

Customer must exercise reasonable care to assure that the electrical characteristics of its load and generating equipment, such as deviation from sine wave form or unusual short interval fluctuations. It shall not result in impairment of Customer's service or

service to other Customers, interference with operation of computer, telephone, television, other communication systems or facilities.

(D) ~~(E)~~ Voltage Flicker

The voltage flicker level shall not exceed APS standards measured at the Customer's POI as outlined in the latest version of IEEE 519 and IEEE 1453.

(E) ~~(F)~~ Service Voltage Ranges

~~Customer shall ensure its~~The GF ~~does~~should not cause the RMS voltage at the POI to vary beyond the Favorable Voltage Service Range (Range A) of +/- 5% as specified in ANSI standard C84.1. APS may require the Customer to remedy any voltage excursion caused by the Customers GF at the ~~POI,~~POIor any point along the APS System and/or a neighboring customer's POI outside of this ANSI range~~.~~, by implementing settings to the GF and agreed on by the Customer and APS at the time of interconnection, or in instances where voltage excursions is experienced..

8.5 Voltage Requirements

Customer generating equipment must be rated at 60 Hertz, and be either a single or three-phase system connected at a standard utility voltage that may be selected by Customer subject to ~~utility~~Utility availability at the premises.

~~The DG shall follow, and not attempt to oppose or regulate changes in the voltage at the POI, unless otherwise required by Section 12 of this document.~~

8.6 Labeling Requirements

(A) General Requirements

Customer shall conform to the NEC, as adopted by the local Authority Having Jurisdiction, for labeling of all GF equipment, including the SES. APS will assume responsibility for labeling any utility-owned equipment. All APS-required labels shall consist of a permanently attached weatherproof/UV resistant placard, letters shall be engraved or embossed/raised, and letters will be a minimum of 1/4 inch tall unless otherwise specified by APS. ~~If applicable, any adhesive backing shall be rated for outdoor applications in the Arizona environment with UV inhibitors. It is also acceptable to rivet labels to the applicable equipment as long as the attachment means does not violate the UL Listing of the equipment. Labels shall be~~ All Production Meter and Utility Disconnect labels shall be riveted. All other labels may use the 3M 4930 VHB two-sided adhesive tape. Labels shall be non-ferrous material made of (a) aluminum, brass or other approved corrosive resistant metal, or (b) a high-density polyethylene material 55 mils thick comprised of a 35 mil black polyethylene base film capped (co-extruded) with a 20 mil color polyethylene. Labels should follow the ANSI Z535.1-2011 color codes when applicable.

(B) Disconnect ~~Switch~~

Customer shall label the Disconnect ~~Switch "Generator~~ "Utility Disconnect~~ Switch" or "Photovoltaic System, Wind Turbine, etc., Utility Disconnect Switch", as the case may be.~~". In the event APS grants approval to install the ~~Utility~~ Disconnect ~~Switch~~ at a location other than the electrical SES: (1) Customer shall install a placard at the SES giving concise express directions to, and the location of, the Disconnect ~~Switch~~, and (2)

Customer shall install a placard at the ~~Utility~~ Disconnect ~~Switch(es)~~ giving concise express directions to, and the location of, the SES.

In the event APS allows more than one Utility Disconnect ~~Switch~~ to be installed at a Customer's facility, the ~~switches~~Disconnects shall be labeled 1/x, 2/x, etc. where x is the total number of Utility ~~Disconnect Switches~~Disconnects. When more than one SES exists at a Customer's facility, the disconnect shall be labeled to reference the appropriate SES.

A warning label shall be mounted on the Disconnect ~~Switch~~ front cover with the following words: "Warning: Electric Shock Hazard. Do Not Touch Terminals. Terminals On Both The Line And Load Sides May Be Energized In The Open Position."

Rapid Shutdown initiation device(s) as required in the NEC shall be identified on disconnecting device(s) other than the Utility Disconnect(s).

(C) Production Meter

Customer shall label the Production Meter enclosure and/or socket as "~~Production Meter.~~"Uni-Directional Meter" or "Bi-Directional Meter". When more than one Uni-Directional or Bi-Directional Meter exists at a Customer's facility, the meters shall be labeled to reference the appropriate System such as "Bi-Directional Meter #1" and "Bi-Directional Meter #2", etc. In the event APS grants approval to install the Production Meter at a location other than the SES: (1) Customer shall install a placard at the SES giving concise express directions to, and the location of, the Production Meter, and (2) Customer shall install a placard at the Production Meter(s) giving concise express directions to, and the location of, the SES. When more than one SES exists at a Customer's facility, the meters shall be labeled to reference the appropriate SES.

~~In the event that more than one Production Meter is installed at a Customer's facility, the meters shall be labeled 1/x, 2/x, etc. where x is the total number of Production Meters.~~

Additionally, for metering maintenance, if load-side terminals may be energized by a DG source, a label shall be placed adjacent to or affixed to the Production Meter enclosure stating:

"Warning: Load side terminals may be energized by Backfeed."

(D) Service Entrance Section (SES)

When a ~~photovoltaic~~DER system is connected on the supply (~~utility~~Utility) side of the SES main breaker, in accordance with the NEC and requirements specified in this document, a label shall be placed adjacent to the main service breaker stating:

"Warning: A Generation Source is connected to the Supply (Utility) Side of the Service Disconnecting Means. Follow proper Lock-Out/Tag-Out Procedures to ensure the ~~Photovoltaic System~~ Utility Disconnect ~~Switch~~ is opened prior to performing work on this device."

(E) Meter Disconnect ~~Switch~~

Customer shall label the disconnect ~~switch "Backup Sub-panel"~~"Uni-Directional Meter Line Side Disconnect ~~Switch," "Backup Generator,~~" "Bi-Directional Meter Line Side Disconnect ~~Switch," "PV System,~~" "Bi-Directional Meter DER Side Disconnect ~~Switch~~," etc. as applicable. ~~Customer shall install a placard at the SES giving concise directions~~

to,See APS Sample and the location of, the Meter Disconnect Switch.Concept Diagrams at www.aps.com/dg.

8.71.1 Protective Relaying Requirements

(A) (A) General Requirements

(1) Customer shall be solely responsible for properly protecting and electrically paralleling its generator(s) and/or static inverter(s) with the APS System.

(2)(1) For Generators, Customer facility shall include an automatic interrupting device (normally the generator breaker) that is rated to interrupt available fault (short circuit) current and is tested and certified to applicable UL standards. The interrupting device shall be directly tripped (and not via a programmable logic controller, etc.), as a minimum, by all protective devices required herein. If a Local/Remote control selector switch or any other component is wired in series with the trip and/or close circuit, said component(s) shall not impede or bypass any of the protective devices required herein, or the ability to trip/close the automatic interrupting device. Breakers downstream of the main shall have adequate overcurrent protection (i.e., 50, 51, 50N and 51N).

(3)(1) Inherent characteristics of induction disk type voltage and frequency relays render their use unsuitable for some generator interface protection applications. Therefore, relays with definite level and timing characteristics (e.g., solid state type relays) will be necessary to meet the minimum requirements established herein.

(4)(1) For Rotating Generator classes II and greater (> 50 kW) utilizing discrete relays that require both voltage and frequency relay protection, separate and independent voltage and frequency relays and associated trip paths to the automatic interrupting device are required. This is to ensure a redundant trip function in the event of a single relay failure or out-of-tolerance condition.

It is acceptable however, for the over/under voltage functions to be integrated into a single o/u voltage relay, and for the over/under frequency functions to be integral to a single o/u frequency relay.

As an option, the frequency and voltage functions may be incorporated into a single microprocessor-based protective relay provided that the relay incorporates relay failure alarm contacts, and such output is wired to trip the automatic interrupting device upon (1) relay failure or (2) loss of power to the relay. In lieu of tripping the automatic interrupting device, and with APS approval, Customer may configure the relay to alert a 24-hour Operations Center for a relay failure condition.

(5) For Rotating Generator protective schemes that utilize microprocessor based, multi-function relays, the protective relay failure alarm contacts will be configured to trip the automatic interrupting device. This requirement shall also apply to any GF utilizing static inverters with an aggregate nominal nameplate rating of 1,000 kW and greater.

(6)(1) The protective scheme referenced in Section 8.7(A)(5) above shall be of a fail-safe design such that loss of the protection scheme control power will (immediately) cause the automatic interrupting device to open. Additionally, control power to the relay shall be fed via a dedicated hard-wired UPS circuit.

(7)(1) With the addition of generation at a Customer site, ground fault current magnitude might increase to level where the existing grounding grid is insufficient to protect personnel from step or touch potentials. Customer shall ensure the adequacy of the facility grounding grid to keep any step and touch potentials at a safe level.

(8)(1) Customer shall ensure that the GF protective relaying and controls are adequately protected from electrical surges that may result from lightning, utility switching or electrical faults.

(9)(1) A Rotating Generator utilizing a Momentary Parallel Transition transfer scheme shall install an independent backup timer that directly trips the main breaker(s) feeding the SES. The trip circuit shall not be routed through any circuits or logic scheme that could inhibit or block the trip signal, and not via a PLC, etc. Refer to Section 13.2 for additional details.

(10) A GF comprised of one or more generators with an AC continuous nameplate rating of 10 MW or greater will be required to be equipped with Automatic Voltage Regulating (AVR) capability, the capability to operate in Power Factor Control (PFC) mode, and the capability to operate in Mvar Control mode as specified in Section 12.1.

(11) Any GF comprising static inverters with an aggregate generator nominal nameplate rating of 10 MW or less and interconnecting with a Non-Dedicated Utility Feeder, shall utilize inverters that have been tested and certified to UL 1741 with Advanced Inverter functionality (UL 1741 SA or subsequent UL equivalent supporting the latest IEEE 1547 standard), by a NRTL certified by OSHA to perform the UL 1741 SA test standard. The programming/set points shall be determined per APS and proof of such shall be provided by Customer (i.e., certified test report, inverter settings print out, and/or APS inspection/validation). Default mode shall be set to unity power factor unless otherwise determined by APS. Measurement accuracy shall be in accordance with the latest IEEE 1547 test standard.

In the event a Power Control System (PCS) is installed at the GF, the PCS shall be capable of meeting the advanced inverter functions/features as noted in IEEE 1547-2018. The PCS shall additionally meet the requirements specified in NEC Art. 705.13. APS will evaluate the aggregate AC nameplate capacity of all DERs connected to the PCS to ensure safety and reliability of the APS System.

NOTE: Appropriate system sizing and inverter selection will eliminate potential curtailment of real power output when operating the GF at other than unity power factor. APS strongly recommends that Customer take this into consideration during the GF design. Appropriate Generator nameplate capacity may need to be installed at the GF to achieve a specified real power output when operating in the control modes specified below (i.e., appropriate kW/kVA ratio sizing to support operation at ± 0.95 power factor).

At a minimum, the following grid support features are required unless otherwise specified by APS:

a. Volt/var Mode – Voltage/VAR control through dynamic reactive power injection through autonomous responses to local voltage measurement

b. Volt/Watt Mode – Voltage/Watt control though dynamic active power injection through autonomous responses to local voltage measurement

c. Fixed Power Factor – Reactive power by a fixed power factor

d. Constant Reactive Power – Reactive power by a fixed percentage of kVA rating of the inverter nameplate (limited to 44%).

e. Anti-Islanding – Support anti-Islanding to trip off under extended anomalous conditions

f. Low/High Voltage Ride-Through (LHVRT) – Ride-through of low/high voltage excursions beyond normal limits

g. Low/High Frequency Ride-Through (LHFRT) – Ride-through of low/high frequency excursions beyond normal limits

h. Ramping – Capability to define active and reactive power ramp rates (typically managed by a DER plant control system)

i. Settings shall not cause voltage excursions outside of the limits specified in Section 8.4(F).

ii. Ramp rate (kW/minute) shall not exceed limits specified within Section 4.10 of IEEE 1547-2018.

i. Soft-Start Reconnection – Reconnect after grid power is restored

j. Cease to Energize – Capability to remotely turn off active power delivery (only as needed/required by APS)

k. Power Curtailment – Capability to remotely curtail the active power production within the range of 0% to 100% (only as needed/required by APS)

l. Frequency/Watt Mode – Frequency/Watt control to counteract frequency excursions beyond normal limits by decreasing or increasing real power

(12)(1) For all GF installed on or after June 10, 2019, APS requires the GF shall provide voltage regulating capabilities at the POI unless otherwise determined by APS. APS will advise Customer of specific settings as noted in Section 8.7(A)(11) and Section 12.1 of this document (e.g., power factor, reactive power and/or automatic voltage regulation) and any associated set point(s) during the Interconnection Application process. Customer will be fully responsible for implementing any identified recommendations.

(13)(1) APS reserves the right to require curtailment of GF real power output in the event APS System issue occurs (i.e., power quality). Curtailment can be accomplished via utility grade metering, plant control equipment, operating the Utility Disconnect Switch and/or the individual inverter level (for Static Inverter based GF) as determined by APS. In addition, remote operable curtailment required at APS' option.

(14) For GF comprising static inverters with an aggregate nominal nameplate rating of 250 kW and greater installed to address an APS System issue (i.e., NWS, power

quality, etc.) shall install microprocessor backup relaying such as a SEL 351-7 or equivalent (i.e., intertie relay) with functions/features and parameters determined by APS in accordance with this manual and/or any state, local and/or national standards (for example, IEEE 1547-2018). The microprocessor relay shall trip the GF over-current device(s) for any out of tolerance conditions. Additional communication and control circuitry/capability may be required. Reference Section 11 for additional details. In addition, provisions for power quality metering along with appropriate isolation (i.e., visual open disconnecting means) as required for troubleshooting and maintenance will be required.

NOTE: APS may opt to apply this requirement for GF comprising static inverters with an aggregate nominal nameplate rating less than 250 kW in the event the interconnection occurs on a stressed utility feeder.

(15) Any GF comprising static inverters with an aggregate generator nominal nameplate rating of 10 MW or less, and interconnecting with a Dedicated Utility Feeder, shall utilize inverters that have been tested and certified as specified in Section 8.7(A)(10), or Customer shall ensure, at a minimum, that the inverter performance tests specified below are performed and certified by a NRTL to ensure compliance with the following Sections of IEEE 1547-2018 (per Section 40.1 of UL 1741), effective January 1, 2022:

Section 7 Power Quality

a. Section 7.1 Limitation of DC injection

b.a. Section 7.2 Limitation of voltage fluctuations induced by the DER

c.a. Section 7.3 Limitation of current distortion

d.a. Section 7.4 Limitation of overvoltage contribution

Customer shall provide APS with a copy of the test results and certification from the NRTL, for APS review and approval.

(16) Any GF comprising static inverters with an aggregate generator nominal nameplate rating of greater than 10 MW and interconnecting with a Dedicated Utility Feeder, shall be equipped to support the options specified per Section 12.1. However, Customer shall ensure, at a minimum, that the inverter performance tests specified below are certified by a NRTL to ensure compliance with the following Sections of IEEE 1547-2018 (per Section 40.1 of UL 1741), effective January 1, 2022:

Section 7 Power Quality

a. Section 7.1 Limitation of DC injection

b.a. Section 7.2 Limitation of voltage fluctuations induced by the DER

c.a. Section 7.3 Limitation of current distortion

d.a. Section 7.4 Limitation of overvoltage contribution

Customer shall provide APS with a copy of the test results and certification from the NRTL, for APS review and approval.

(A) (B) Minimum Relaying Requirements

(1) (1) Class I (Single or Three Phase: 50 kW or less)

a. The minimum protection required for induction and synchronous generators is an under-voltage relay.

b.a. Synchronous generators require a synchronizing scheme, either manual with a synch check relay, or an automatic synchronizer.

c. Static inverters shall be tested and certified to UL 1741/1741 SA, by a NRTL certified by OSHA to perform the UL 1741/1741 SA test standard.

(2) Class II (Three Phase: 51-300 kW)

a. The minimum protection required for induction and synchronous generators is under-voltage, over-voltage, under-frequency, and over-frequency.

b.a. Synchronous generators require a synchronizing scheme, either manual with a synch check relay, or an automatic synchronizer.

c. Inverters shall be tested and certified to UL 1741/1741 SA, by a NRTL certified by OSHA to perform the UL 1741/1741 SA test standard, unless otherwise provided for in Section 8.7(A).

d. A redundant over/under voltage and over/under frequency relay (single microprocessor-based relay) may be required for static inverters with an AC output nominal rating of ≥250 kW, or whenever the aggregate inverter AC output nominal rating of a GF ≥250 kW.

e.a. For installations interconnected to the utility through a transformer with connections that will not supply current to a ground fault on the Utility System, a ground fault detector may be necessary. APS will advise Customer of any such requirements after a preliminary review of Customer's proposed installation.

f.a. Other equipment such as supervisory control and alarms, telemetering and associated communications channel may be necessary. This is especially the case when the generator, or an aggregate of generators, is large relative to the minimum load on a feeder or sectionalized portion thereof. APS will advise Customer of any communications requirements after a preliminary review of the proposed installation. Refer to Section 11 for more details.

(1) (3) Class III (Three Phase: 301-5,000 kW)

a. For this class of installation, utility grade protection devices and equipment are required.

b.a. The minimum protection required for induction and synchronous generators is under-voltage, over-voltage, under-frequency, over-frequency, and negative sequence time overcurrent.

c.a. Synchronous generators require a synchronizing scheme, either manual with synch check relay, or an automatic synchronizer.

d. Static inverters shall be tested and certified to UL 1741/1741 SA, by a NRTL certified by OSHA to perform the UL 1741/1741 SA test standard, unless otherwise provided for in Section 8.7(A).

e. A redundant over/under voltage and over/under frequency relay (single microprocessor based relay) may be required for static inverters with an AC output nominal rating of ≥250 kW, or whenever the aggregate inverter AC output nominal rating of a GF ≥250 kW.

f.a. For installations interconnected to the utility through a transformer with connections that will not supply current to a ground fault on the Utility System, a ground fault detector may be necessary. The utility will advise Customer of any such requirements after a preliminary review of Customer's proposed installation.

g.a. Other equipment such as supervisory control and alarms, telemetering, and associated communications channel may be necessary. APS will advise Customer of any requirements after a preliminary review of the proposed installation. Refer to Section 11 for details.

(4) Class IV (Three Phase: Greater than 5,000 kW)

NOTE: Induction Generators or Line Commutated Inverters in this size range are not anticipated.

a. For this class of installation, utility-grade protective devices and equipment are required.

b.a. Relays for under-voltage, over-voltage, under-frequency, and over-frequency are required.

c.a. Synchronous generators require a synchronizing scheme, either manual with synch check relay, or an automatic synchronizer.

d.a. A ground time overcurrent and ground instantaneous overcurrent relay, or for installations interconnected to the utility through a transformer with connections that will not supply current to a ground fault on the Utility System, a ground fault detection scheme is required. APS will advise Customer of any such requirements after a preliminary review of Customer's proposed installation.

e.a. The following protective functions are also required:

i. Voltage-controlled time overcurrent

ii.i. Loss of excitation

iii.i. Over-excitation

iv.i. Negative sequence time overcurrent

f. Other equipment such as supervisory control and alarms, telemetering, and associated communications channel are generally required. APS will advise Customer of any such requirements after a preliminary review of the proposed installation. Refer to Section 11 for further details.

The minimum protective relaying requirements for parallel operation of distributed generation are summarized in the table below. An exception to the relaying requirements on the

~~following table may be made for Momentary Parallel Transition systems – refer to Section 13.2 for applicable requirements.~~

~~Note that depending on the specific application of the GF, a Reverse Power relay may be required. APS will advise Customer of any such requirement after a preliminary review of the proposed installation.~~

Summary of Minimum Protective Relaying Requirements

	Induction Generator	Synchronous Generator	Static Inverter
Class I 50 kW or less	Undervoltage	Undervoltage, Synchronizing	*UL 1741 or UL 1741 SA
Class II 51 to 300 kW	Overvoltage, Undervoltage Overfrequency, Underfrequency	Overvoltage Undervoltage, Overfrequency, Underfrequency Synchronizing	*UL 1741 or UL 1741 SA
Class III 301 to 5,000 kW	Overvoltage, Undervoltage Overfrequency, Underfrequency Negative Sequence Time Overcurrent	Overvoltage, Undervoltage, Overfrequency, Underfrequency Synchronizing Negative Sequence Time Overcurrent	*UL 1741 or UL 1741 SA ** Refer to Sections 8.7(A), 11, and 12 for additional GF aggregate requirements.
Class IV Greater than 5,000 kW	No induction generators of this size anticipated	Overvoltage, Undervoltage, Overfrequency, Underfrequency, Synchronizing, Ground Time Overcurrent, Ground Instantaneous Overcurrent, Voltage-controlled Time Overcurrent, Loss of Excitation, Overexcitation, Negative Sequence Time Overcurrent	*UL 1741 or UL 1741 SA ** Refer to Sections 8.7(A), 11, and 12 for additional GF aggregate requirements.

*Inverters shall be tested and certified to UL 1741/1741 SA unless the requirements specified in Sections 8.7(A) and 12.1 apply. Redundant O/U voltage and O/U frequency protection may be required for individual inverters with an AC output nominal rating of ≥250 kW, or whenever the aggregate inverter AC output nominal rating of a GF is ≥250 kW. Such protection shall be applied to one or more breakers external to the inverter(s).

**For utility scale installations utilizing static inverters with an aggregate AC output nominal rating of ≥10 MW a redundant O/U voltage and O/U frequency protection will be required. Such protection shall be applied to one or more breakers external to the inverter(s) (i.e., the main GF breaker(s)). Refer to Section 11 for further details.

(C) Relay Settings

NOTE: Voltage and frequency relays needed for minimum interface protection for all classes will have setting limits as specified below with exception to Generating Facilities subject to advanced grid support voltage and frequency settings in accordance with Section 8.7(A)(11), and/or 12.2 of this document.

(1) Under-voltage relays will operate at no less than 80% of the nominal voltage level and will have a maximum time delay of 1.0 seconds.

(2)(1) Over-voltage relays will operate with a maximum time delay of 1.0 seconds for a voltage range of higher than 110% and less than 120% of nominal voltage. The relay will operate instantaneously at 120% or higher of nominal voltage to provide a maximum clearing time of 10 cycles.

(3)(1) Under-frequency relays will operate at no less than 58 Hz and have a maximum time delay of 1.0 seconds.

(4)(1) Over-frequency relays will operate in 6 cycles above 60.5 Hz. Maximum clearing time of the breaker will be 10 cycles.

(5)(1) Additional settings for Class I, II, III & IV installations and/or any other relays that may be required due to unusual circumstances will be handled on an individual basis.

9 METERING REQUIREMENTS

This Section applies to any Generating Facility that electrically parallels with the APS System other than a Backup Generator.

9.1 Service Entrance Section Metering

Customer must provide and install, at Customer's expense, meter sockets and metering cabinets in accordance with APS service standards, in Readily Accessible locations acceptable to APS, to accommodate any meter(s) that are required by applicable rate schedule(s) or other APS agreement (e.g., Totalized Metering) or other APS requirements (e.g., EMS Meter). Such standards are specified in the APS Electric Service Requirements Manual (ESRM), available at the following website: www.aps.com/ESRM.

Metering Installation Requirements are addressed in Section 300 of the ESRM.

APS will furnish, own, install and maintain meter(s) located at the GF SES as required by APS, and any meter(s) that may be required by the applicable electric rate schedule to measure the output of the Generator(s). The responsibility for the costs of providing and maintaining any required meters and communication circuitry as required will be specified in the applicable rate schedule or other APS agreement. Refer to Section 9.3 of this document for Metering Communication requirements.

Any Metering provided by APS as described in this Section shall be located in appropriately sealed compartments, and no Customer wiring, connections, or equipment is permitted in any such APS sealed metering compartment or pull-section of the SES.

9.2 Production Metering Requirements

All Generating Facilities other than those comprising a Backup Generator must include provisions to allow APS to install an AMI type Production Meter (or Meters as the case may be). This Metering shall be configured ~~so as~~ to measure and record the AC energy production of the Generator(s).

Production from a Generating Facility must be associated with only one billing meter and shall be designed to offset the load associated with only that (billing) meter.

The Production Meter enclosure and associated equipment must be installed in compliance with Section 300 of the APS Electric Service Requirements Manual (ESRM), available on APS' website. A valid neutral is required for APS Metering to work properly.

Until such time that APS installs the APS-owned Production Meter, Customer has the option of either installing a Customer-owned "test meter" or an approved meter cover over the meter socket. **Under no circumstances is the meter socket to be left open or otherwise exposed at any time.** Once Customer notifies APS that the GF is ready for the APS site inspection and/or Production Meter installation, APS will schedule the installation of its Production Meter. APS will then remove any Customer installed test meter(s) or meter cover(s), install an AMI type Production Meter along with any associated metering equipment, and seal the meter socket ring and metering enclosure.

An approved meter cover will be a commercially available meter cover designed and approved by the manufacturer for outdoor use on meter sockets. It shall be constructed of materials such as fiberglass, rigid plastic, and glass. Note that a cardboard cover (typically

used for shipping purposes) is not an acceptable material. The meter cover shall be properly installed and sealed to the meter socket.

Under no circumstances shall any metering enclosure be used as a junction box, raceway, or wireway.

For Current Transformer (CT) rated installations (greater than 200A), APS will install the Production Meter, CTs, any PTs, test switches and required wiring. Customer shall be responsible for installing, in accordance with APS' requirements a ring type production metering enclosure with meter socket. Customer shall adhere to the following additional requirements:

(A) For Secondary Voltage systems (phase to phase voltage less than 600V) of 200A and less, Customer shall provide a ring type self-contained metering enclosure and a meter per the APS ESRM. Note that safety test blocks are not required for commercial (or residential) installations. For Secondary Voltage systems greater than 200A (with phase to phase voltage less than 600V), Customer shall provide a ring type CT rated enclosure per the APS ESRM.

(B) For Medium Voltage systems (phase to phase voltage 600V and higher), Customer shall provide a medium voltage lineup along with grounding provisions per the APS ESRM.

(C) For Static Inverter based Energy Storage Systems (i.e., battery backup systems), Customer shall provide production metering provisions in accordance with APS Sample Diagrams. ~~In some cases, such as with battery backup systems, isolation on either side~~Isolation on both sides of the ESS Production Meter is required for metering maintenance. In addition, the ESS Production Meter shall be labeled when load side terminals may be energized by a DG source in accordance with Section 8.6(C). The APS Sample Diagrams can be downloaded at ~~www.aps.com/dg. In some cases, based on the inverter technology and/or GF configuration, two or more ring-type metering sockets/enclosures must be provided and installed by Customer.~~www.aps.com/dg.

(D) Production Meter enclosures/sockets shall be labeled in accordance with Section 8.6 (C) of this document.

Customer shall provide and maintain communication circuitry depending on the applicable rate schedule or other APS agreement. Refer to Section 9.3 of this document for Metering Communication requirements.

All CT rated metering enclosures shall have the bus identified with reference to the generation source side prior to metering installation with a ~~temporary~~semi-permanent tag/mark labeled "Generation Source."

Customer must provide a suitable ~~visual-~~visible open disconnecting means, subject to APS' approval, to electrically isolate any CT rated meter from all potential sources of power. For meters installed on systems with a phase to phase voltage of 600V or higher, suitable grounding provisions shall also be required in accordance with the APS ESRM (Section 1100) and subject to APS approval.

~~Option: For Static Inverters certified to UL 1741/1741SA, all CT Rated Production Meters with phase to phase voltage less than 600V may, in place of a visual open switch, utilize circuit breaker(s) or disconnect switch(es) with locking provisions per OSHA LOTO requirements with an APS padlock to isolate the Generator source side of the CT Rated~~

~~Metering Equipment. The generator source disconnect shall be located in the same workspace as the meter and be 24/7 accessible. This option is subject to APS review and approval. APS will not accept electronic disconnect devices (i.e., push-button type). This option does not preclude the need for a visual open Disconnect Switch on the Line Side/Utility side of the CT Rated Production Meter required per Section 8.2.~~

All CT rated metering enclosures shall be submitted by equipment manufacturer ~~to~~through an APS Representative for review and approval by the APS meter shop ~~for review and approval~~ in accordance with the APS ESRM. Submittal shall clearly indicate the points of connection of the Utility and Generator sources.

~~In order to submit to the APS Meter shop, do the following:~~

- ~~E-mail shop drawings of the metering enclosure to: submittals.metershop@apsc.com.~~
- ~~Reference the GF System Address and GF System Type (wind, photovoltaic, energy storage, induction generator, synchronous back-up generator, etc.).~~

Drawing submittal shall include: engineering and manufacturer one-lines, manufacturer (name), EUSERC page references that are applicable, ampacity, physical dimensions, voltage, phase, bus bracing (AIC rating), padlockable provisions, accurate address (street and number), GF system type, etc.

Such metering enclosure shall be tested and marked to withstand the available short circuit current (Reference NEC Art 110.9, NEC Art 110.10, OSHA 1910.303(b)(4) and OSHA 1910.303(b)(5)).

Production Meters shall be installed in a Readily Accessible location (available 24 hours) to provide safe (no tripping hazards, domesticated animals or other obstructions, etc.) and unrestricted access to APS personnel per APS Requirements. This includes but is not limited to Section 300 of the APS ESRM and Service Schedule 1 ("Terms and Conditions for Standard Offer and Direct Access Services"). Customer provided metering enclosures shall be installed adjacent to Customer's SES and ~~disconnect switches~~disconnects unless otherwise approved by APS. The Production Meter shall not be:

(1) located behind an electrically operated gate or door unless the electric operator is backed up by an uninterruptible power source to ensure that it can be operated in the event of a utility power outage.

(2) installed under a breezeway, patio, porch or any area that can be enclosed.

(3) installed behind a gate, fence, wall or other barrier.

(4) mounted to a non-permanent structure (including a masonry wall, fence, etc.) unless utilizing service support specifications as noted in Section 306.0 of the APS ESRM.

NOTE: APS may grant an exception to commercial Customers who locate equipment (i.e., APS Production Meter and its associated disconnect ~~switch(es~~(s)) behind a locked door or gate just as long as the equipment is installed in a safe location (no tripping hazards, domesticated animals or other obstructions, etc.). In this case, APS can provide a lock-box to be installed by the commercial Customer for APS to gain access

to the Production Meter or any other APS equipment, the lock-box needs to be installed within 36" of the door or gate, etc., and it shall be located no less than 36" above grade and no more than 60" above grade. Note that any indoor equipment locations require access from the exterior of the building. A placard or directory must be installed at the SES with concise directions to, and the location of, the Production Meter(s) and associated Disconnect ~~Switch(es(s~~).

All metering disconnects shall adhere to the same requirements outlined in Section 8.2 as for the Utility Disconnect.

9.3 Metering Communication

Where the applicable rate schedule or other APS agreement requires billing meter(s) to be installed on the output of the facility Generators, Customer will provide acceptable meter sockets and/or enclosures in accordance with the APS ESRM. APS will install AMI meters to measure the output of the Generators. For Generating Facilities 1 MW and greater, APS has additional requirements for metering and associated communication. Refer to Section 11.4(C) of this document for more information.

In the event that it is not possible to install AMI meters, Customer will be required to provide a dedicated analog dial tone phone line to each Production Meter and also to the GF SES utility meter(s) and/or sub meters if necessary. Each dedicated phone line is to be landed on the APS-provided telephone interface module, normally located within two feet of the meter. The phone line is referred to as a Single Business Line, Type 1FB, and should be ordered with NO additional features such as Call Waiting, Call Transfer, Call Hold, Message Waiting, etc., and no long distance service.

For network systems with IPBX or VoIP, an IP to analog (or gateway) device with modem pass through capabilities shall be installed by Customer and shall support analog modem service of 56kBps and higher. The IP to analog device shall also support CCITT V.90 and CCITT V.92 standards, and lower.

Customer is responsible for paying monthly fees for dedicated analog phone lines. In the event phone service is disrupted, Customer is responsible for resolving the issue.

Customer will be advised at time of application if APS has additional requirements for production metering and/or communication circuitry.

9.4 Third-Party Customer Metering

If Customer installs third-party metering equipment, Customer shall ensure that no wiring, or other Customer-owned equipment enters into any APS sealed compartment or enclosure. Customer-provided CT circuitry for DG systems required to measure loading installed inside the SES shall be split core. CTs and associated circuitry installed shall be in accordance with the NEC and manufacturers' instructions, and shall not violate the UL listing of the SES or other panelboards (if installed in different locations). Proof of such may be required by APS. **Customer-installed meters and associated equipment installed to measure Generator output shall be located on the Generator side of APS' Production Meter. Third party metering equipment must be clearly labeled to distinguish it from the APS Production Metering equipment.** Refer to the Example Equipment Tags located at www.aps.com/dg.

Any connections made on the Generator side of the Production Meter in order to accommodate third-party metering or monitoring equipment shall be of negligible load so as to not affect the GF output as measured on the Production Meter.

~~10~~ RATE SCHEDULES APPLICABLE TO DISTRIBUTED GENERATION

10 PROTECTION

10.1 Design Considerations and Definition of Classes

Protection requirements are influenced by the size and characteristics of the parallel generator along with the nature and operational characteristics of the associated APS System. Therefore, similar units connected to different lines could have different protection requirements based on varying load conditions, as well as on utility feeder and transformer characteristics.

(A) Synchronous Units

Synchronous generators are generally capable of supplying sustained current for faults on the APS System. These units can also supply isolated APS load providing the load is within the units' output capability.

Reclosing of the Utility power source onto synchronous units must be blocked to prevent out-of-sync paralleling and must also be prevented from energizing a de-energized utility line. Automatic reclosing by APS is time-delayed which allows for automatic Customer Generator separation prior to re-energization of the utility source.

(B) Induction Units

Induction generators are basically induction motors that are mechanically driven above synchronous speed to produce electric power. These units do not have a separate excitation system and, as such, require that their output terminals be energized with AC voltage and supplied with reactive power to develop the magnetic flux. Induction generators are therefore normally not capable of supplying sustained fault current into faults on the Utility System. Such units are generally not capable of supplying isolated load when separated from the Utility System; however, it is possible for an induction generator to become self-excited if a sufficient amount of capacitance exists at its output terminals.

Under conditions of self-excitation, an induction generator will be capable of supplying isolated load, providing the load is within the units' output capability. In most cases when self-excitation occurs, it will be accompanied by a sudden increase in terminal voltage. APS and its other Customers must be protected from out-of-phase closing and over-voltages that can occur whenever an induction generator becomes self-excited. Induction units must therefore be designed to automatically separate from the Utility System upon loss of utility voltage and prior to reclosing of the utility feeder.

(C) Static Inverters

Static inverters convert DC power to AC by means of electronic switching. Switching can be controlled by the AC voltage of the utility's supply system (line-commutated) or by internal electronic circuitry (forced-commutated).

Line-commutated inverters are generally not capable of operating independently of the utility's AC supply system, cannot normally supply any appreciable fault current, or

continue to energize isolated loads provided proper protective functions are in place. To accommodate such protective functions, any line-commutated inverter that is electrically paralleled with the APS System shall be tested and certified to UL 1741 Standard for Inverters, Converters and Controllers for use in Independent Power Systems, (including Supplements SA and SB* or subsequent UL equivalent supporting the latest IEEE 1547 standard), by a NRTL certified by OSHA to perform the test.

Forced-commutated, or self-commutated, inverters are capable of energizing load independently of the Utility System. Any forced-commutated inverter, the output of which is to be directly interconnected with the Utility, needs to be specifically designed for that purpose. It would need to be designed to accommodate parallel interfacing and operation. To accommodate such control functions, any forced-commutated inverter that is electrically paralleled with the APS System shall be tested and certified to UL 1741 Standard for Inverters, Converters and Controllers for use in Independent Power Systems, (including Supplements SA and SB* or subsequent UL equivalent supporting the latest IEEE 1547 standard), by a NRTL certified by OSHA to perform the test.

* Supplement SB certification requirement shall become effective July 1, 2023.

(D) Definition of Generator Size Classes

The following generator size classifications are used in determining specific minimum protective requirements for distributed GFs. Specified ratings are for each connection to the APS System. Customers must satisfy, in addition to the general requirements specified in this document, the minimum relaying requirements given in this document (Section 10.2) for each generator class.

Class I -- 50 kW or less, single or three phase

Class II -- 51 kW to 300 kW, three phase

Class III -- 301 kW to 5,000 kW, three phase

Class IV -- over 5,000 kW, three phase

10.2 Protective Relaying Requirements

(A) General Requirements

(1) Customer shall be solely responsible for properly protecting and electrically paralleling its generator(s) and/or static inverter(s) with the APS System.

(2) For Generators, Customer facility shall include an automatic interrupting device (normally the generator breaker) that is rated to interrupt available fault (short circuit) current and is tested and certified to applicable UL standards. The interrupting device shall be directly tripped (and not via a programmable logic controller, etc.), as a minimum, by all protective devices required herein. If a Local/Remote control selector switch or any other component is wired in series with the trip and/or close circuit, said component(s) shall not impede or bypass any of the protective devices required herein, or the ability to trip/close the automatic interrupting device. Breakers downstream of the main shall have adequate overcurrent protection (i.e., 50, 51, 50N and 51N).

(3) Inherent characteristics of induction disk type voltage and frequency relays render their use unsuitable for some generator interface protection applications.

Therefore, relays with definite level and timing characteristics (e.g., solid state type relays) will be necessary to meet the minimum requirements established herein.

(4) For Rotating Generator classes II and greater (> 50 kW) that utilizes discrete relays, separate and independent voltage and frequency relays and associated trip paths to the automatic interrupting device are required. This is to ensure a redundant trip function in the event of a single relay failure or out-of-tolerance condition.

It is acceptable however, for the over/under voltage functions to be integrated into a single o/u voltage relay, and for the over/under frequency functions to be integral to a single o/u frequency relay.

As an option, the frequency and voltage functions may be incorporated into a single microprocessor-based protective relay provided that the relay incorporates relay failure alarm contacts, and such output is wired to trip the automatic interrupting device upon (1) relay failure or (2) loss of power to the relay. In lieu of tripping the automatic interrupting device, and with APS approval, Customer may configure the relay to alert a 24-hour Operations Center for a relay failure condition.

(5) For Rotating Generator protective schemes that utilize microprocessor based, multi-function relays, the protective relay failure alarm contacts will be configured to trip the automatic interrupting device. This requirement shall also apply to any GF utilizing static inverters with an aggregate AC output nominal nameplate rating of 1000 kW and greater.

(6) The protective scheme referenced in Section 10.1(A)(5) above shall be of a fail-safe design such that loss of the protection scheme control power will (immediately) cause the automatic interrupting device to open. Additionally, control power to the relay shall be fed via a dedicated hard-wired UPS circuit.

(7) With the addition of generation at a Customer site, ground fault current magnitude might increase to a level where the existing grounding grid is insufficient to protect personnel from step or touch potentials. Customer shall ensure the adequacy of the facility grounding grid to keep any step and touch potentials at a safe level.

(8) Customer shall ensure that the GF protective relaying and controls are adequately protected from electrical surges that may result from lightning, utility switching or electrical faults.

(9) A Rotating Generator utilizing a Momentary Parallel Transition transfer scheme shall install an independent backup timer that directly trips the main breaker(s) feeding the SES. The trip circuit shall not be routed through any circuits or logic scheme that could inhibit or block the trip signal, and not via a PLC, etc. Refer to Section 13.2 for additional details.

(10) The GF shall provide voltage regulating capabilities at the POI unless otherwise determined by APS. APS will advise Customer of specific settings as noted in Section 10.1(A)(13) and Section 12 of this document (e.g., power factor, reactive power and/or automatic voltage regulation) and any associated set point(s) during the Interconnection Application process. Customer will be fully responsible for implementing any identified recommendations.

(11) APS reserves the right to require curtailment of GF real power output in the event APS System issue occurs in an abnormal or unplanned event. Curtailment can be accomplished via utility grade metering, plant control equipment, operating the Utility Disconnect and/or the individual inverter level (for Static Inverter based GF) as determined by APS. In addition, remote operable curtailment required at APS' option.

(12) For GF comprising static inverters installed to address an APS System issue as a non-wires solution shall install microprocessor backup relaying such as a SEL 351-7 or equivalent (i.e., intertie relay) with functions/features and parameters determined by APS Study in accordance with this manual and/or any state, local and/or national standards (for example, latest IEEE 1547). The microprocessor relay shall trip the GF over-current device(s) for any out of tolerance conditions. Additional communication and control circuitry/capability may be required. Reference Section 11 for additional details. In addition, provisions for power quality metering along with appropriate isolation (i.e., visible open disconnecting means) as required for troubleshooting and maintenance will be required.

NOTE: APS may opt to apply this requirement for GF comprising static inverters with an aggregate AC output nominal nameplate rating less than 250 kW in the event the interconnection occurs on a stressed utility feeder.

(13) Any GF comprising static inverters with an aggregate generator AC output nominal nameplate rating of 10 MW or less, and interconnecting with a Dedicated Utility Feeder, shall utilize inverters that have been tested and certified as specified in Section 12(A), or Customer shall ensure, at a minimum, that the inverter performance tests specified below are performed and certified by a NRTL to ensure compliance with the following Sections of latest IEEE 1547 (per Section 40.1 of UL 1741):

IEEE 1547.1 Section 7 Power Quality

a. Section 7.1 Limitation of DC injection

b. Section 7.2 Limitation of voltage fluctuations induced by the DER

c. Section 7.3 Limitation of current distortion

d. Section 7.4 Limitation of overvoltage contribution

Customer shall provide APS with a copy of the test results and certification from the NRTL, for APS review and approval.

(14) Any GF comprising static inverters with an aggregate generator AC output nominal nameplate rating of greater than 10 MW and interconnecting with a Dedicated Utility Feeder, shall be equipped to support the options specified per Section 12. However, Customer shall ensure, at a minimum, that the inverter performance tests specified below are certified by a NRTL to ensure compliance with the following Sections of latest IEEE 1547 (per Section 40.1 of UL 1741):

IEEE 1547.1 Section 7 Power Quality

a. Section 7.1 Limitation of DC injection

b. Section 7.2 Limitation of voltage fluctuations induced by the DER

c. Section 7.3 Limitation of current distortion

d. Section 7.4 Limitation of overvoltage contribution

Customer shall provide APS with a copy of the test results and certification from the NRTL, for APS review and approval.

(B) Minimum Relaying Requirements

(1) Class I (Single or Three Phase: 50 kW or less)

a. For this class of installation, utility grade protection devices and equipment are required.

b. The minimum protection required for induction and synchronous generators is an under-voltage relay.

c. Synchronous generators require a synchronizing scheme, either manual with a synch check relay, or an automatic synchronizer.

(2) Class II (Three Phase: 51-300 KW)

a. For this class of installation, utility grade protection devices and equipment are required.

b. The minimum protection required for induction and synchronous generators is under-voltage, over-voltage, under-frequency, and over-frequency.

c. Synchronous generators require a synchronizing scheme, either manual with a synch check relay, or an automatic synchronizer.

d. A redundant over/under voltage and over/under frequency relay (single microprocessor-based relay) may be required for static inverters with an AC output nominal nameplate rating of ≥250 kW, or whenever the aggregate inverter AC output nominal nameplate rating of a GF ≥250 kW.

e. For installations interconnected to the Utility through a transformer with connections that will not supply current to a ground fault on the Utility System, a ground fault detector may be necessary. APS will advise Customer of any such requirements after a preliminary review of Customer's proposed installation.

f. Other equipment such as supervisory control and alarms, telemetering and associated communications channel may be necessary. This is especially the case when the generator, or an aggregate of generators, is large relative to the minimum load on a feeder or sectionalized portion thereof. APS will advise Customer of any communications requirements after a preliminary review of the proposed installation. Refer to Section 11 for more details.

(3) Class III (Three Phase: 301-5,000 kW)

a. For this class of installation, utility grade protection devices and equipment are required.

b. The minimum protection required for induction and synchronous generators is under-voltage, over-voltage, under-frequency, over-frequency, and negative sequence time overcurrent.

c. Synchronous generators require a synchronizing scheme, either manual with synch check relay, or an automatic synchronizer.

d. A redundant over/under voltage and over/under frequency relay (single microprocessor based relay) may be required for static inverters with an AC output nominal nameplate rating of ≥250 kW, or whenever the aggregate inverter AC output nominal nameplate rating of a GF ≥250 kW.

e. For installations interconnected to the Utility through a transformer with connections that will not supply current to a ground fault on the Utility System, a ground fault detector may be necessary. The Utility will advise Customer of any such requirements after a preliminary review of Customer's proposed installation.

f. Other equipment such as supervisory control and alarms, telemetering, and associated communications channel may be necessary. APS will advise Customer of any requirements after a preliminary review of the proposed installation. Refer to Section 11 for details.

(4) Class IV (Three Phase: Greater than 5,000 kW)

NOTE: Induction Generators or Line Commutated Inverters in this size range are not anticipated.

a. For this class of installation, utility grade protective devices and equipment are required.

b. Relays for under-voltage, over-voltage, under-frequency, and over-frequency are required.

c. Synchronous generators require a synchronizing scheme, either manual with synch check relay, or an automatic synchronizer.

d. A ground time overcurrent and ground instantaneous overcurrent relay, or for installations interconnected to the Utility through a transformer with connections that will not supply current to a ground fault on the Utility System, a ground fault detection scheme is required. APS will advise Customer of any such requirements after a preliminary review of Customer's proposed installation.

e. The following protective functions are also required:

i. Voltage-controlled time overcurrent

ii. Loss of excitation

iii. Over-excitation

iv. Negative sequence time overcurrent

f. Other equipment such as supervisory control and alarms, telemetering, and associated communications channel are generally required. APS will advise Customer of any such requirements after a preliminary review of the proposed installation. Refer to Section 11 for further details.

The minimum protective relaying requirements for parallel operation of distributed generation are summarized in the table below. An exception to the relaying requirements on the

following table may be made for Momentary Parallel Transition systems – refer to Section 13.2 for applicable requirements.

Note that depending on the specific application of the GF, a Reverse Power relay may be required. APS will advise Customer of any such requirement after a preliminary review of the proposed installation.

Table 10.2 *Summary of Minimum Protective Relaying Requirements*

	Induction Generator	Synchronous Generator	Static Inverter
Class I 50 kW or less	Undervoltage	Undervoltage, Synchronizing	*UL 1741, and *IEEE 1547
Class II 51 to 300 kW	Overvoltage, Undervoltage Overfrequency, Underfrequency	Overvoltage Undervoltage, Overfrequency, Underfrequency Synchronizing	*UL 1741 and IEEE 1547
Class III 301 to 5,000 kW	Overvoltage, Undervoltage Overfrequency, Underfrequency Negative Sequence Time Overcurrent	Overvoltage, Undervoltage, Overfrequency, Underfrequency Synchronizing Negative Sequence Time Overcurrent	*UL 1741 and IEEE 1547 ** Refer to Sections 10.1(A), 11, and 12 for additional GF aggregate requirements.
Class IV Greater than 5,000 kW	No induction generators of this size anticipated	Overvoltage, Undervoltage, Overfrequency, Underfrequency, Synchronizing, Ground Time Overcurrent, Ground Instantaneous Overcurrent, Voltage-controlled Time Overcurrent, Loss of Excitation, Overexcitation, Negative Sequence Time Overcurrent	*UL 1741 and IEEE 1547 ** Refer to Sections 10.1(A), 11, and 12 for additional GF aggregate requirements.

*Inverters shall be tested and certified to UL 1741 Standard for Inverters, Converters and Controllers for use in Independent Power Systems, (including Supplements SA and SB or subsequent UL equivalent supporting the latest IEEE 1547 standard), by a NRTL certified by OSHA to perform the test. Supplement SB certification requirement shall become effective July 1, 2023.

Redundant O/U voltage and O/U frequency protection may be required for individual inverters with an AC output nominal rating of ≥250 kW, or whenever the aggregate inverter AC output nominal nameplate rating of a GF is ≥250 kW. Such protection shall be applied to one or more breakers external to the inverter(s).

**For utility scale installations utilizing static inverters with an aggregate AC output nominal nameplate rating of ≥10 MW a redundant O/U voltage and O/U frequency protection will be required. Such protection shall be applied to one or more breakers external to the inverter(s) (i.e., the main GF breaker(s)).

(C) Relay Settings

(1) NOTE: Voltage and frequency relays needed for minimum interface protection for all classes will have setting limits as specified below. Under-voltage relays will operate at no less than 80% of the nominal voltage level and will have a maximum time delay of 1.0 seconds.

(2) Over-voltage relays will operate with a maximum time delay of 1.0 seconds for a voltage range of higher than 110% and less than 120% of nominal voltage. The relay will operate instantaneously at 120% or higher of nominal voltage to provide a maximum clearing time of 10 cycles.

(3) Under-frequency relays will operate at no less than 58 Hz and have a maximum time delay of 1.0 seconds.

(4) Over-frequency relays will operate in 6 cycles above 60.5 Hz. Maximum clearing time of the breaker will be 10 cycles.

(5) Additional settings for Class I, II, III & IV installations and/or any other relays that may be required due to unusual circumstances will be handled on an individual basis.

10.1 APS Rate Schedules and Rate Riders

There are various rate schedules and rate riders applicable to Customer-owned generation that electrically parallels with the APS electric distribution system. Note that participation under a particular rate schedule or rate rider is subject to the GF qualifying for that specified rate schedule or rate rider.

These rate schedules and rate riders are available at www.aps.com.

The rates specified do not apply to backup or standby generation that is used solely for emergency purposes, and that parallels with the utility for brief periods in order to effect a power transition from the utility to the backup generation and vice versa.

10.2 Rates Disclaimer

(A)1. APS electric rates, basic charges and service fees are subject to change. Future adjustments to these items may positively or negatively impact any potential savings or the value of Customer's GF.

(B)1. Customer will be responsible for paying any future increases to electric rates, basic charges or service fees from APS.

(C)1. Customer's GF is subject to the current rate schedules and rate riders, rules and regulations established by the ACC. The ACC may alter its rules and regulations and/or change rates in the future that could directly impact the economics of Customer's GF.

(D)1. APS and/or the ACC do not sponsor or approve any future electric rate projections presented to Customer. These rates are based on projections formulated by external third parties not affiliated with APS and/or the ACC.

11 ADDITIONAL REQUIREMENTS FOR GF ≥ ONE (1) MW

This Section covers additional requirements that apply to any one GF or aggregate of GFs with a combined AC output nominal nameplate ~~output~~ rating of 1 MW or greater, interconnected with the APS System for Continuous Parallel operation.

The 1 MW threshold applies to one or more Generators (a) connected to any single APS metered point of electric service delivery or (b) connected to multiple metered points of electric service delivery connected to a single APS System Source Device.

A GF with an aggregate generator AC output nominal nameplate ~~AC~~ rating of less than 1 MW will not typically need to incorporate the requirements specified in this Section. However, depending on the GF's impact to the APS System, APS may require the GF to incorporate one or more of the requirements outlined in this Section.

APS will identify the actual requirements, and the optimum method of implementation, normally as part of the Interconnection Study (refer to Section 16.7). APS can also assist Customer in addressing any design requirements prior to submitting an application and drawings for review.

Modifying GF AC system output (kW) that does not involve the modification of any installed equipment such as controller programing, setting field or software modification that was in place to limit power (i.e., power limiting) will require notification to APS, and may require secondary nameplate/placards be installed to alert the Customer, their contractors and APS personnel working on the equipment in the future.

11.1 Transfer Trip

Transfer trip requirement will be evaluated based on the result of an interconnection study and agreed upon the Customer and APS.

(A) A Transfer Trip scheme will normally comprise a relay located at the APS substation feeder breaker that communicates via fiber optic cable with a relay located at the GF along with associated control circuits. Whenever the APS substation breaker opens, a trip signal is sent to the GF to automatically trip the generation off line.

(B) If GF is fed from a Dedicated Utility Feeder, and it is determined during the interconnection review process that a transfer trip scheme is needed, APS will require Customer to install a relay and communication link that interfaces with the APS substation relay. In the event that a transfer trip is required, Customer will need to install and maintain a Schweitzer SEL 351-7 relay for transfer trip control of the Generator breaker along with the associated instrumentation transformers and circuitry. APS will install, at Customer's expense, a SEL 351-7 relay at the APS substation.

(C) In accordance with the APS ESRM, APS will provide Customer with the overcurrent relay settings (50, 50N, 51, and 51N) for the SEL 351-7 relay located at the GF for coordination with the SEL 351-7 relay at the APS substation. Customer will activate device functions 27 (Undervoltage), 59 (Overvoltage), and 81 O/U (Over/Under Frequency) in the SEL 351-7 relay located at the GF with trip set points in accordance with Section 8.7(C) of this document. Customer shall incorporate a relay failure alarm in accordance with 8.7(A)(5) of this document. Customer will submit settings for APS review and approval.

(D) In the event that there is a loss of Mirrored Bits communication between the APS Substation relay(s) and GF relay(s), the GF breaker(s) shall trip open via the GF relay(s) settings. It is acceptable to add a 15 cycle delay for loss of Mirrored Bits within the GF relay(s) settings to avoid nuisance trips.

11.2 Remote Trip

(A) A Remote Trip is a manual trip signal issued by the APS Control Center to trip the generation ~~off line~~offline and isolate it from the APS Distribution System. This signal will normally be communicated via fiber optic cable originating at the APS substation or by a radio frequency via an antenna. It will generally trip the generator breaker(s) via a Customer installed breaker control circuit.

(B) A GF with an aggregate generator AC output nominal nameplate rating less than 1 MW will not typically require remote trip capability specified. However, depending upon the GF's impact on the APS System, APS may require remote trip and remote monitoring capability.

(C) The Remote Trip function will be accomplished via a Remote Terminal Unit (RTU) provided by APS at Customer's expense and the cabinet and connections will be installed by Customer at Customer's Facility.

(D) For a GF comprising static inverters located on a non-Dedicated Utility Feeder, should APS need to switch the section of the normal feeder on which the GF is located to another feeder for line/breaker maintenance, feeder sectionalizing/switching, and/or load transfer operations, APS reserves the right, without liability, to remotely trip the GF off-line for the duration of any such operation.

(E) If adverse operating conditions occur on the APS System due to the GF, APS reserves the right to open the Generator breaker without notice until such conditions are addressed. Customer will assume full responsibility for the inverters shutting down in accordance with UL 1741~~/1741 SA/IEEE 1547~~ in the event of a utility outage or system fault.

(F) For a GF located behind a primary meter on a Dedicated Utility Feeder, an exception to the remote trip requirements may be granted by the Energy Delivery Compliance Committee (EDCC). APS Planning, Operations and Interconnection Engineering shall mutually agree to submit the exception request to EDCC prior to the request submittal. Remote monitoring or GF production data in 15 minute intervals may still be required.

11.3 Remote Monitoring

(A) The GF shall be equipped for remote monitoring by the APS Control Center. APS will install, at Customer's expense, an EMS Meter (in addition to the billing meter) along with communication wiring in the SES incoming metering section to provide instantaneous Watts, kVA, vars, Volts, Power Factor, Amps and cumulative kWh readings to the RTU.

(B) For all installations, Customer must provide two meter sockets and two sets of test switches at the SES metering compartment in accordance with the APS ESRM – one set for the EMS Meter and the other for the billing meter. APS may elect to temporarily install, and at APS's expense, transducers in place of the EMS Meter, in the event this meter is not available at the time of the GF start-up. Once the EMS meter becomes available, APS will coordinate with Customer to install it and remove the transducers.

(C) For Behind the Meter/R-DER applications, in addition to metering located at the SES as required per Section 11.3(A) above, a meter is required to be installed to monitor the Generator output. Customer will provide a metering section in accordance with the APS ESRM. APS will install, at Customer's expense, an EMS meter along with communication wiring in the metering section to provide instantaneous Watts, vars, Volts and cumulative kWh readings to the RTU.

(D) Customer will provide hard-wired open/close contact (b contact) status points and control wiring to the RTU for any breaker with Remote Control capability by APS so that APS can monitor the status of this breaker remotely.

11.4 Technical Details

(A) At Customer's expense, APS will provide, operate and maintain an RTU. Customer shall install the RTU enclosure as provided by APS, and APS will install and program the RTU. Customer shall provide a 120 VAC, 15 Amp (minimum) power supply to the RTU, and shall install 2" rigid metallic conduits for all required circuits associated with the RTU. The 120VAC/15A circuit must be from a dedicated feed upstream from the Generator breaker, so it remains energized in the event the Generator breaker is open. The RTU and associated equipment installed at the GF must be located at a Readily Accessible location (available 24 hours) for APS personnel. For all PPA/Customer Owned GF, the dedicated 120 VAC circuit shall not be backed up via Customer provided UPS.

(B) The RTU will be housed in an enclosure along with an appropriate communication device (e.g., fiber converter, or modem as specified by APS), and battery backup system. The RTU enclosure typically measures 36"X30"X10", and is a NEMA 3R outdoor rated cabinet. Additional RTUs may be required if a single RTU cannot be located in the immediate vicinity of the SES and any required metering on the generation output. The top of the RTU cabinet shall not exceed more than 6' from final grade.

(C) Customer is responsible for securing a communication path back to the APS communication system (e.g., fiber optic back to APS Substation). In the event the communication path is disrupted for any reason, Customer is responsible for remedying the issue.

In some instances, APS may provide a communication path back to the APS communication system via a MAS radio. Customer will be responsible for all associated costs, and shall also provide a location to install antennas tall enough to provide line of sight from the MAS radio antenna to APS communication towers in the area.

(D) In the case the communication system located at the APS Substation (or designated APS location) communicating back to the APS EMS system cannot support the additional data points, Customer will be responsible for upgrading the communication path. The cost of any communication upgrades, and the monthly service fee will be passed on to Customer.

(E) Equipment and means of completing the communication path will be determined by APS and communicated to Customer during the Interconnection Study process (refer to Section 16.7).

(F) Customer will provide, install and maintain Generator breaker control circuitry ("Breaker Control Scheme") that will accept two remotely initiated control functions from the APS EMS system through the APS RTU (for each generation breaker). If a Local/Remote

control selector switch or any other component is installed and wired in series with the trip and/or close circuit associated with the Generator Breaker, the APS remote trip & block close/close permissive control circuit must not be impeded. APS must be able to remotely trip the Generator breaker open regardless of the position of the Local/Remote control switch.

(1) Trip Function: Contacts will close momentarily when APS issues a trip command through the RTU.

The trip function contacts within the APS RTU are "dry" (not powered by APS). Maximum ratings for the contacts on the trip relay in the APS RTU are as follows:

- 10A, 120VAC
- 3A, 125 VDC
- 10A, 28VDC

(2) Remote Close Function: Contacts will close momentarily when APS issues a remote close command through the RTU.

The close function contacts within the APS RTU are "dry" (not powered by APS). Maximum ratings for the contacts on the trip relay in the APS RTU are as follows:

- 10A, 120VAC
- 3A, 125 VDC
- 10A, 28VDC

NOTE: Remote Close Function is only required for APS Owned projects with an RTU. Customer may opt to install a separate remote close scheme for Customer owned GFs.

(3) Close Permissive/ Block Close Function: Contacts will latch in the closed position when APS enables a close permissive command. Contacts will latch in the open position when APS disables the close permissive, i.e., issues a block close.

The generator breaker control logic will allow Customer to operate associated breaker. However, it will be necessary for APS to enable the close permissive first, allowing Customer to close the breaker.

NOTE: The only acceptable means by which the GF breaker(s) is permitted to be closed shall be via the breaker control circuitry (locally or remotely). Circumventing the breaker control circuitry by manually closing the GF breaker(s) for purposes of energizing the GF is not allowed by APS. Customer shall disable manual closure of the GF breaker(s) by installing a mechanical blocking accessory (i.e., close defeat cover plate) or other means acceptable to APS.

The close permissive function contacts within the APS RTU are "dry" (not powered by APS). Maximum ratings for the contacts on the close permissive relay in the APS RTU are as follows:

- 10A, 120VAC
- 0.5A, 125 VDC

- 10A, 28VDC

Customer is responsible for providing an interposing relay and any associated power source if needed to ensure that the APS RTU contact ratings are not exceeded.

Depending on the GF system configuration, these functions may be applied to either individual Generator breaker within Customer gear or to a single main Generator breaker for the GF in order to isolate the Generator(s) from the APS System.

NOTE: APS will provide a "wetting" voltage of 24 VDC for Customer generation breaker status contacts. APS will require an AC/DC schematic diagram for the Breaker Control Scheme as part of interconnection diagram submittal showing terminal connections and sequence of operations of the trip and close permissive/block close functions.

(G) APS can provide upon request Sample Diagrams showing typical RTU/Communication requirements. These requirements must be incorporated on the final Electrical One-Line Diagram required for APS interconnection review.

(H) Customer shall include an Uninterruptable Power Supply (UPS) or battery bank with a DC to AC inverter for any required Breaker Control Scheme and any SEL 351-7 relay to be operational if the normal power source should fail. The UPS shall be capable of supplying backup power for at least six continuous hours and shall be hard-wired (a "plug in" UPS is not acceptable).

(I) Customer will perform periodic maintenance on the UPS batteries to ensure that it remains in operational condition at all times. Documentation that the UPS has been tested and is operational as part of the APS final inspection.

11.5 Project Details

(A) Circuit requirements are dependent on generation size and all system additions and system improvements to meet the needs of Customer for its DG installation. Any additions/improvements to the APS System as a result of the DG installation will be expensed to Customer. A cost summary will be provided to Customer as part of the Interconnection Study (refer to Section 16.7).

(B) The materials required for the RTU and specialized metering are long lead time items taking as long as 4 months to receive. APS cannot allow Customer to place the GF on-line until after all APS and Customer required work outlined in the Interconnection Study (refer to Section 16.7) has been completed and all applicable requirements being implemented as delineated in APS Interconnection Requirements.

(C) Customer is advised to communicate need dates to APS as soon as practically possible so as to avoid project delays.

(D) A communication shelter may be required (specifically for APS owned projects) to house the Supervisory Control and Data Acquisition (SCADA), communication, and any security equipment. At Customer's option, a second service can be provided at the applicable retail rate and system voltage for the communication shelter electrical service. In such cases, APS will coordinate the RTU and associated communication equipment arrangement and installation details with Customer.

(E) The communication shelter will be provided and installed by Customer. Customer shall provide and install instrumentation racks inside the communication shelter. Racks shall be properly grounded utilizing #4/0 copper wire. A GPS clock shall also be provided and installed by Customer (i.e., Arbiter Systems 1094B GPS Substation Clock). Customer shall provide time synch from the GPS clock to the protective relays installed at the medium voltage switchgear.

(F) If a communication shelter is required APS suggests ample time be allotted for ordering, delivering, and installation of the communication shelter and associated equipment. All conduits, wiring, and components related to the SCADA, communication, and any security system shall be installed prior to final commissioning. APS will provide additional details during the construction phase.

(G) Any proposed generation 1 MW and greater will normally require an APS System Impact Study (SIS) to determine the impact to the APS System. Please refer to Section 16.7 of

the APS Interconnection Requirements for additional details. Depending on the results of the SIS, APS may require a Dedicated Utility Feeder. The following are potential triggers used to determine the need for a Dedicated Utility Feeder, which will be required for all U-DER applications:

(1) A GF greater than ½ of a typical APS distribution feeder rating.

(2) In Metro, the typical distribution feeder rating is 13 MW/MVA, but the rating could be less in State Region depending on the area.

(3) A Rotating Machine (i.e., synchronous generator) normally 1MW and greater.

(4) If it is determined that the DG penetration limits of the distribution feeder will be exceeded.

(5) The aggregated generation (including the GF) shall not exceed 50% of the distribution feeder's continuous rating.

(6) The Customer is expected to pay the cost for designing, installing and maintaining the installation of a Dedicated Utility Feeder interconnecting to the APS System.

12 ADVANCED GRID SUPPORT FEATURES

The requirements outlined in this Section apply to any GF ~~with an aggregate nominal nameplate AC output rating of 10 MW and greater,~~ interconnected with the APS System and configured for ~~Continuous~~ Parallel Operation. These requirements are in addition to those specified in Sections 8, 10 and 11 of this document. ~~Note that any~~Any GF ~~of this rating will~~may require an Interconnection Study per Section 16.7 of this document.

~~A GF with an aggregate generator nominal nameplate AC rating of less than 10 MW will not typically require the Operational Control Modes specified in this Section. However, depending upon the GF's impact to the APS System, APS may require the GF to operate in one or more of the modes specified in Section 12.1(A)(1), (2) and (3) below. In addition, for a Static Inverter based GF, Advanced Inverter functions/features will be required as noted in Section 8.7(A)(11). Any such~~ Additional requirements will be identified in the Interconnection Study or as otherwise determined by APS.

NOTE: Appropriate system sizing and inverter selection may reduce potential curtailment of real power output when operating the GF at other than unity power factor. APS strongly recommends that Customer take this into consideration during the GF design. Appropriate Generator nameplate capacity may need to be installed at the GF to achieve a specified real power output when operating in the control modes specified below (i.e., appropriate ~~will eliminate potential curtailment of real power output when operating the GF at other than unity power factor. APS strongly recommends that Customer take this into consideration during the GF design. Appropriate Generator nameplate capacity may need to be installed at the GF to achieve a specified real power output when operating in the control modes specified below (i.e., appropriate~~ MW/MVA ratio sizing to support operation at ± 0.9 or ±0.95 power factor refer to section 12.4 for requirement).

~~**12.1 Dynamic Response Requirements**~~

~~**(A)** Operational Control Modes:~~

12.1 Reactive Power Capability, Voltage Regulation Performance and Abnormal Response

(A) GF < 10MW

APS requires all inverters to be tested and certified to UL 1741 (See Section 10.1(C)). All inverters shall meet minimum operating capabilities in compliance with DER normal operating performance Category B and abnormal operating performance Category III per the latest IEEE 1547 standard. APS will provide standard default settings. An APS Interconnection Study may determine settings other than the default settings are required. If the GF cannot perform the functions in the provided settings, the modified settings, the programming, set points, and specific settings will be agreed upon between the Customer and APS.

(B) GF ≥ 10 MW

Any GF, that parallels with the APS System with an aggregate generator AC output nominal ~~AC~~ nameplate rating of 10 MW and greater, shall be capable of meeting all of the operational/control modes specified below. As part of the Interconnection Study, APS will specify whether these operational/control modes shall be measured at the inverters, SES or POI. This point is known as the "Point of Measurement" (POM).

(1) Capability to operate in PFC mode at a fixed power factor as agreed upon bewteen the Customer and APS within the range of at least plus or minus 0.95 power factor at any power output level up to the maximum rated MW output of the GF. If the POM is different from the POI, it may be necessary to have a wider range of power factor set points in order to deliver enough reactive power to the POI. Power Factor Control mode is defined as a site varying its reactive power output to achieve a constant power factor output. PFC may be unstable at very low loads. GFs may revert to unity power factor operation when operating below 10% of nameplate MW capacity. Battery Storage based GFs should be able to operate in Power Factor Control mode whenever importing or exporting more than 10% of nameplate MW capacity.

(2) Customer shall set the GF to operate at the APS default setting of PFC with a 0.98 leading setpoint unless a different set point or operating mode is specified by APS. Leading from APS perspective means: absorbing reactive power (bucking) into the GF when exporting real power, and exporting reactive power (boosting) out of the GF when importing real power. It is acceptable for Customer to achieve this default setting at the Generator output terminals.

(3) The reactive power level calculated at 0.95 power factor (either lagging or leading) with the GF producing full rated real power output represents the required reactive power capability of the GF. The GF must be capable of delivering or absorbing this amount of reactive power at the POI in any of the active control modes specified in this Section.

~~(2)~~(4) Capability to operate at any fixed reactive power (Mvar) output at any power level within the full reactive power range calculated in 12.1(~~A)(1~~B)(3) above while the GF is producing power. Battery Storage GFs should be able to operate at any fixed reactive power output level within the range calculated in 12.1(~~A)(1~~B)(3) while the inverters are connected to the grid.

~~(3)~~(5) Capability to operate in AVR mode to regulate the voltage to a selected nominal voltage range of 0.~~95%~~95p.u. to 1.~~05%~~05p.u. at the POM, to the extent that such voltage regulation can be achieved with the available reactive power calculated in Section 12.1(A)(1).

(6) Voltage regulation shall be within 0.~~50%~~005p.u. of the voltage set point.

(7) From time to time, APS will specify whether Customer will operate the GF in PFC, Mvar or AVR mode. APS will specify the associated set point. Such specification may be based upon the results of the Interconnection Study and/or changes to, or conditions arising on, the APS System.

(8) ~~(B)~~ Capability to operate in a standard Volt-Var mode.

12.2 Plant Controller and System Performance Requirements:

~~(1)~~(A) ~~The~~A GF ~~shall incorporate~~that incorporates a suitable controller (e.g., "Power Plant Controller" or "Dynamic Reactive Device") shall be capable of operating/controlling the GF in all of the modes specified in ~~Section~~ 12.1(~~A)(1), (2), and (3) above.~~B).

~~(2)~~(B) Performance requirements: Upon the controller receiving a step change in a reference point value, the plant ~~should~~controller shall begin to respond within 500 ms (refer to t_1

and t_2 on Figure 1). The controller shall drive the plant output to 90% of the new reference point value within 4 seconds of receiving the step input (refer to t_3 on Figure 1), and shall settle/damp out to a final value within 8 seconds of step input irrespective of operating mode (refer to t_4 on Figure 1). Overshoot in any mode shall not exceed 0.055% of aggregate rated reactive power for the site.

(3)(C) Customer shall provide written control system specifications that shall include an executive summary as to howdetailing the operation of the control system works. The control system operation and meetsspecifications shall comply with all applicable APS requirements noted,and shall include, but not limited to, the bill of materials, control system block and single line diagram(s)), and the anticipated performance parameters. The customer shall submit the control system specifications and executive summary to APS for APS review and acceptance.

(4)(D) Customer shall provide a written performance testing procedure as part of the drawing and application submittal. A sample procedure and/or checklist may be provided by APS.

(5)(E) Once the GF is on-lineenergized at full power output, Customer shall be ready to complete performance testing of the GF within ten (10) business days. Customer will contact APS to coordinate scheduling of the performance testing on mutually agreed upon date(s). In the event APS personnel are not available to witness any/all performance testing, Customer shall provide a certified test report and supplemental information that demonstrates conformance to APS requirements noted herein for APS's review and acceptance.

A supplemental document outlining Dynamic Voltage/VAR Response Testing Procedures is available at: www.aps.com/dg.

(6)(F) In the event of a control system failure, (e.g., loss of communication) the GF shall be configured to revert to the default setting as specified in Section 12.1(A)(1). APS must be notified as soon as possible in the event of a control system failure, but no later than the following business day.

NOTE: For a Static Inverter based GF, if plant-wide power factor control were to fail (e.g., due to a blown PT fuse), the GF may revert to inverter-controlled fixed power factor mode with a local power factor setting of 0.98 leading.

The control system shall be designed to allow its performance to be evaluated in all three of the operating control modes specified above by inputting a reference step change into the controller. In the case of the AVR mode, the step change shall constitute a change to the plant's desired output voltage set point. Figure 1 below depicts the typical response of a plant control system to a step change at time t_1. The time t_3 to reach 90% of the final output value is noted on the plot as well. After the output has attained 90% of its final value, there may be some overshoot and oscillatory response until the plant output settles out to its final value at t_4. There will be a small difference between the final value and the desired value specified by the set point. This difference is expressed as a percent error band referenced to the desired set point versus the actual final value.

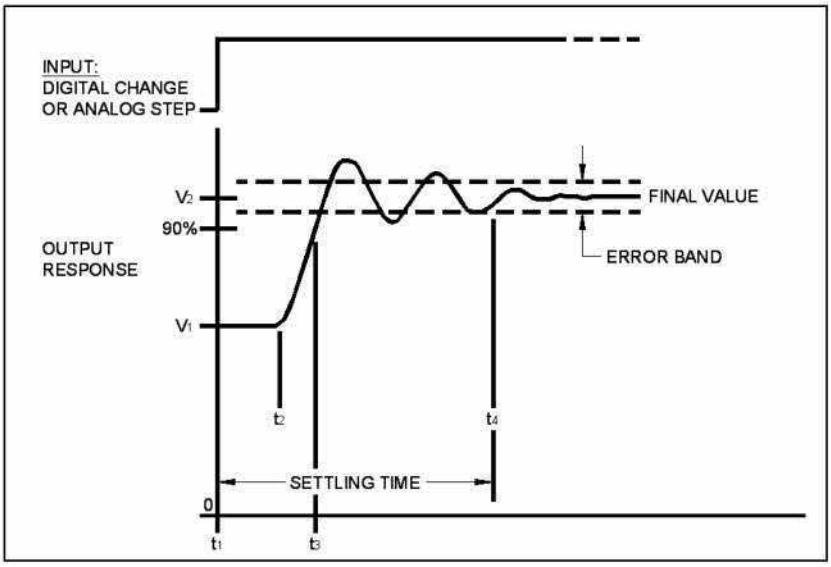

Figure 1 – Generalized Plant Response to a Reference Step Input Change

~~(7)~~(G) If APS contacts Customer to change the operating mode or set point, Customer will implement request within four (4) hours if request is made between the hours of 6:00 am to 4:00 pm. If request is made outside these hours, request must be implemented by 8:00 am the following morning. Any such request will be made by the APS Energy Control Center (ECC).

12.3 ~~12.2~~ Latest NERC Standard PRC-024~~-2~~ Frequency and Voltage Ride-Through Requirements

The requirements outlined in NERC Standard PRC-024~~-2~~ (Standard) apply to any GF interconnected to the APS System ~~with an aggregate nominal nameplate AC output rating.~~ Although this standard does not directly apply to distribution-based GFs, we are choosing to apply it to these facilities to increase overall reliability of ~~10 MW or greater~~the power system. APS may grant an exception to a GF interconnected to a non-dedicated distribution feeder, if ride-through will interfere with other APS protection, or if there are concerns with unintentional islanding. As a system, the entire GF must ride through the disturbances described in this Standard. This includes but is not limited to relay settings, Static Inverter ride-through settings, and, in the case of synchronous generators, the excitation system settings. This requirement also applies to grid monitoring settings in an inverter that result in Momentary Cessation of active current injection.

GFs subject to this Standard shall submit documentation depicting individual systems' Frequency Capability Curves, Trip Times, Voltage Ride-Through Time Duration Curves and any other information explaining how the GF meets the Standard. Customer shall provide an overlay of voltage and frequency ride-through capability for the site superimposed on top of the PRC-024~~-2~~ Standard curves. For frequency, the WECC values specified in this Standard shall be used.

All settings must be outside of PRC-~~024-2's~~024's "No Trip" zone. The developer must take into account the accuracy of the frequency calculation internal to the equipment when

considering near instantaneous frequency protection. Frequency trip settings shall not be set shorter than 100 ms.

While all settings must comply with PRC-024-2, voltage and frequency trip settings should not be based solely on these curves. These settings should account for physical equipment limitations to protect the GF and distribution system. For all GFs, it is important to adequately evaluate voltage protection settings according to attachment 2 of PRC-024 to ensure that voltage protection settings at the GFs' terminals comply with the standard for voltage deviations at the POI.

Static Inverter based GFs are expected to continue current injection throughout the entire PRC-024-2 "No Trip Zone" for frequency and voltage. If "Momentary Cessation" in this zone is unavoidable due to hardware limitations, "Momentary Cessation" settings should be adjusted to allow the site to continue current injection for as much of the "No Trip Zone" as possible.

Any Static Inverter that enters a "Momentary Cessation" mode due to a grid voltage or frequency excursion shall be set to reconnect to the grid as quickly as possible once grid conditions return to normal. Ramp rate for the site upon return from momentary cessation should be set to 100% per second unless APS specifies a slower ramp rate based on an Interconnection Study.

Additional guidance on "Momentary Cessation" can be found in Chapter 1 of the NERC "BPS-Connected Inverter-Based Resource Performance Reliability Guideline," September 2018.

12.4 Power Factor

At a minimum all GFs paralleling with the APS grid shall have power factor capabilities per Table 12.4.

Table 12.4 *GF Minimum Power Factor Requirements*

Technology	Location for PF requirement	Minimum PF capability	Maximum PF capability
Inverter < 10MW	At the terminals of the inverter	Abs/Inj[1] 0.90	Nameplate[2]
Inverter ≥ 10 MW	At the POI	Abs/Inj[1] 0.95	Nameplate[2]
Synchronous machine	At the terminals	Abs/Inj[1] 0.95	Nameplate[2]

[1] The term absorbing vars, or Abs., refers to vars flowing towards the GF. The term injecting vars, or Inj., refers to vars flowing away from the GF.
[2] Full nameplate capability for var support is based on Customer and APS agreement

13 SOURCE TRANSFER EQUIPMENT

The requirements outlined in this Section apply to a Customer facility utilizing Source Transfer Equipment to transfer all or part of the facility electrical load between two or more power sources – typically one source being the Utility and the other being a Backup Generator. This Section provides supplemental information to that outlined in Sections 4 and 8 of this document.

Typically, Source Transfer Equipment consists of either a transfer switch listed to UL 1008/1008A, or a true double throw switch listed to UL 98. This equipment meets APS Open Transition requirements; therefore, customer is not required to install a Utility Disconnect ~~Switch~~.

Other types of Source Transfer Equipment may be comprised of custom-built transfer schemes, such as Kirk-key interlocks, two main transfers, main-tie-mains, etc. These are not listed to UL 1008/1008A and are considered by APS to be a potential Backfeed source. Therefore, customer will be required to install a Utility Disconnect ~~Switch~~ and submit drawings showing the interlock logic for APS review and approval.

While either a Transfer Switch or Transfer Scheme may be used to transfer Customer load between a ~~Utility~~utility source and a Backup Generator, a Transfer Scheme must be used when transferring from one ~~Utility~~utility source to another ~~Utility~~utility source, for instance when a Customer SES is fed via two ~~Utility~~utility services. While Backup Generators are designed to primarily operate in a stand-alone mode (electrically isolated from the ~~Utility~~utility source) in order to power emergency load, they may be designed to electrically parallel with the ~~utility~~Utility for short periods (< 15 seconds) in order to effect a power transition between power sources.

All Source Transfer Equipment shall have adequate interrupt ratings and fault withstand capabilities in accordance with paragraphs 1910.303(b)(4) and 1910.303(b)(5) of OSHA Rules and Regulations as well as NEC Articles 110.9 and 110.10.

The connection with, and the operating modes of, Source Transfer Equipment connected to the APS System is subject to APS review and acceptance as is described below. APS may request additional details following APS receipt of a Customer Application and associated Supplementary Information submitted in accordance with Appendix A and the APS Interconnection Application Process Guide available at ~~www.aps.com/dg~~.www.aps.com/dg. An Interconnection Study may be required depending on the size, configuration, location, and/or operating mode of the Source Transfer Equipment. APS will advise Customer of any such requirement following an initial engineering review of the proposed design.

NOTE: In instances where APS provides multiple (redundant) electric services (feeder sources) to a Customer facility, Customer is prohibited from ever paralleling the Utility services (sources) in a CTT mode, (neither via a Momentary or Smooth or Smooth Parallel Transition transfer) when effecting a power transfer between the services. Refer to the APS ESRM, Section 104.12 "Protection and Isolation Requirements for Multiple Utility Services to a Customer Facility" for additional information.

13.1 Open Transition Transfer Equipment

(A) Open Transition Transfer Switch:

Provided the Transfer Switch is (i) installed in accordance with the NEC and the APS ESRM, and (ii) meets the requirements for a Separate System as specified in Section 4.1 of this document, then Customer will not be required to install a Utility Disconnect ~~Switch~~ and will

generally not be required to enter into an Agreement with APS. Customer shall submit an electrical one-line diagram, and transfer switch specifications in accordance with the APS Interconnection Application Process Guide available at www.aps.com/dg.

(B) Open Transition Transfer Scheme:

Backup Generator Transfer Scheme: If Customer desires to install an open transition transfer scheme in order to transfer to or from a Backup Generator source, that is not tested and certified to UL 1008/1008A, or otherwise does not meet all of the requirements specified for a Separate System in Section 4.1 of this document, then Customer shall submit an Application along with applicable Supplementary Information in accordance with Appendix A and the APS Interconnection Application Process Guide available at ~~www.aps.com/dg.~~www.aps.com/dg. Customer's design shall include a Utility Disconnect ~~Switch (or Switches~~(s) as specified in Section 8.2 of this document that will completely isolate Customer's GF from the APS System. Following APS's review and acceptance of the proposed design, APS will develop a Non-Parallel Connection Agreement and possibly an Operating Agreement for execution by APS and Customer. Customer shall not put the Backup Generator into service until the installation has been satisfactorily inspected by APS and written notification has been provided by APS.

Utility Services Transfer Scheme: When Customer installs a transfer scheme in order to perform an open transition transfer from one ~~Utility~~utility source (service) to another ~~Utility~~utility source, then the installation shall comply with the requirements outlined in Section 104.12 of the APS ESRM.

13.2 Momentary Parallel Transition

A Momentary Parallel Transition transfer is accomplished by paralleling the Utility and Backup Generator(s) power sources (when both sources are in synchronism) for a time period not to exceed ~~167~~100 milliseconds (~~ten~~six cycles at 60 Hz) in order to effect a load transfer. Power to the load is not interrupted during the transfer. Such a transfer may be accomplished via either a CTT switch (tested and certified to UL 1008/1008A), or via a CTT scheme (not certified to UL 1008/1008A) and is classified as a Parallel System.

Customer shall submit an Application along with associated Supplementary Information in accordance with Appendix A and the APS Interconnection Application Process Guide, available at ~~www.aps.com/dg~~www.aps.com/dg, for APS review and acceptance. Following APS acceptance of the proposed design, APS will develop an Interconnection Agreement and possibly an Operating Agreement for execution by APS and Customer.

The requirements outlined in this document for a Parallel System apply to a GF utilizing a Momentary Parallel Transition transfer switch or scheme, including the requirement for a Utility Disconnect ~~Switch (or Switches~~(s) as specified in Section 8.2 of this document that will completely isolate Customer's GF from the APS System.

The following additional technical requirements apply:

~~(1)~~(A) A primary timer shall be installed to limit the closed transition period to a maximum of ~~167~~100 milliseconds~~.~~ (six cycles at 60 Hz). The timer shall begin timing when the two power sources are paralleled through their respective circuit breakers (Utility breaker and Generator breaker) and shall trip open either one or the other breaker within the specified time.

~~(2)~~(B) In lieu of the minimum protective relaying requirements specified in Section 8.7 of this document, Customer may elect to install a redundant independent backup timer. This backup timer shall be configured to trip, at a minimum, a utility source circuit breaker that is independent of the breakers constituting the transfer switch or scheme in the event the primary timer fails to break parallel between the power sources within the specified time. The backup timer shall:

~~a.~~(1) Begin timing concurrently with the primary timer.

~~b.~~(2) Be set to a maximum time of 1 second.

~~c.~~(3) Directly trip the independent circuit breaker in order to break parallel between the sources in the event of a malfunction (i.e., extended parallel beyond 167 milliseconds) of the normal transfer sequence. The trip circuit shall not be routed through any circuit or logic scheme that could potentially inhibit or block the trip signal, and shall not be routed through a Programmable Logic Controller (PLC) or other such programmable device.

~~d.~~(4) The backup timer and associated circuit design are subject to APS review and acceptance.

~~(3)~~(C) For a transfer switch or scheme equipped with a relay incorporating reverse power protective function(s), such function(s) shall be activated for both the Backup Generator and ~~Utility~~utility source circuit breakers.

For instances where this feature is not available with Closed Transition Transfer switches tested and certified to UL 1008/1008A, APS will not require the reverse power functions.

~~(4)~~(D) Overcurrent lockout protection shall be incorporated into the CTT protective relaying scheme to prevent any source breaker from being manually or automatically closed into a fault.

~~(5)~~(E) When a transfer switch or scheme is manually operated to transfer load between the power sources, automatic retransfer **is not permitted**.

This requirement correlates with the general safety practice that if a transfer is manually initiated, then the re-transfer also needs to be performed manually.

13.3 Smooth Parallel Transition

A Smooth Parallel Transition transfer is accomplished by synchronizing and paralleling the Utility and Backup Generator power sources for a time period of normally 5 to 15 seconds in order to effect a smooth load transfer (sometimes referred to as “soft loading”) between the sources. Power to the load is not interrupted during the transfer. Such a transfer is accomplished via a CTT scheme (not certified to UL 1008/1008A) and is classified as a Parallel System.

Customer shall submit an Application along with associated Supplementary Information in accordance with Appendix A and the APS Interconnection Application Process Guide, available at ~~www.aps.com/dg~~www.aps.com/dg, for APS review and acceptance. Following APS acceptance of the proposed design, APS will develop an Interconnection Agreement and possibly an Operating Agreement for execution by APS and Customer.

The requirements outlined in this document for a Parallel System apply to a GF utilizing a Smooth Parallel Transition transfer scheme, including the requirement for a Utility Disconnect

~~Switch~~ and minimum relaying requirements specified in Section 8 of this document. The following additional technical requirements apply:

(A) Reverse power function(s) shall be activated in the CTT protective relaying for both the Backup Generator and Utility source circuit breakers.

(B) Overcurrent lockout protection shall be incorporated into the CTT protective relaying scheme to prevent any source breaker from being manually or automatically closed into a fault.

(C) When a transfer switch or scheme is manually operated to transfer load between the power sources, automatic retransfer is not permitted.

This requirement correlates with the general safety practice that if a transfer is manually initiated, then the re-transfer also needs to be performed manually.

(D) Prolonged parallel operation greater than 15 seconds of the Customer's GF with the APS System is not permitted nor otherwise agreed upon.

13.4 Closed Transition Transfer Scheme Safety Requirements

The requirements specified in this Section apply to all CTT schemes utilizing a synchronous generator that electrically parallels with the ~~Utility~~utility source. These requirements supplement those outlined in Sections 13.2 and 13.3 of this document.

All Potential Open Points located in the circuit between a Backup Generator output and the ~~Utility~~utility source shall be suitably interlocked to preclude the possibility of a potential out-of-sync closure occurring between the two power sources. A Potential Open Point includes any circuit breaker, contactor, switch, or similar device, (referred to as an "Open Point" in this Section) that is capable of being opened and/or closed, and which is not equipped with either a sync check or synchronizing function.

An Open Point may be interlocked by installing either of the following:

(A) A keyed or other suitable mechanical interlock that will prevent the Open Point from ever being opened unless a circuit breaker in the circuit, which is equipped with either a sync check or synchronizing function, is first opened. This breaker, when opened, shall immediately break the electrical path between the power sources.

(B) An electrical interlock consisting of a set of electrical contacts on the Open Point that are directly wired to instantaneously trip open a circuit breaker in the circuit, which is equipped with either a sync check or synchronizing function, whenever the Open Point is opened. This breaker, upon opening, shall immediately break the electrical path between the power sources.

Closed Transition transfer schemes shall also incorporate the following safety features:

(1) Breaker auxiliary switch contacts to provide transfer scheme interlocks and permissive functions that are in addition to any control switching and interlock functions that may be provided by a microprocessor or PLC based control device. The auxiliary switch contacts shall be connected to the appropriate breaker closing/ tripping control paths.

(2) Fail-safe control circuit design to prevent interlocks from being circumvented in the event of loss of control power.

(3) Close defeat cover plates on the transfer scheme source breakers to prevent inadvertent unsafe out of sequence manual operation.

(4) Provisions that allow both of the transfer scheme source breakers to be in the open and racked-out position at the same time to allow the load to be disconnected from both sources.

(5) Overcurrent lockout protection shall be installed to prevent either source breaker from being closed into a fault.

(6) Electrical equipment subject to the paralleled power sources shall be rated to withstand the combined fault current available from the power sources.

(7) Written procedures and/or interlocks to ensure that automatic transfer and retransfer operations are disabled when either of the transfer scheme source breakers is in the racked-out position. This requirement correlates with general safety practices in LOTO switching procedures.

(8) Protection against islanding and out of phase reclosing shall be installed between a Backup Generator and the ~~Utility~~utility source.

13.5 Main-Tie-Main Transfer Schemes

Main-Tie-Main and Main-Tie-Tie-Main Transfer Schemes (M-T-M Transfer Scheme) typically consist of two or more main source breakers and one or two tie breakers. Such schemes are used to (1) transfer load from one utility source to another, or (2) transfer load between a Utility source and a Backup Generator source (or sources). The requirements for each of these are as follows:

(A) Load Transfer between Utility Sources:

When an M-T-M Transfer Scheme is used to transfer load between Utility sources (services), then the transfer shall be accomplished in an Open Transition Transfer mode to ensure that the Utility sources are never electrically paralleled. The installation shall comply with the requirements outlined in Section 13.1 of this document (refer to "Utility Services Transfer Scheme") and to Section 104.12 of the APS ESRM.

(B) Load Transfer between the Utility and Backup Generator Sources:

When an M-T-M Transfer Scheme is used to transfer load between a Utility source (service) and a Backup Generator source, then the transfer may be accomplished either in an Open Transition Transfer mode or in a Closed Transition Transfer mode. In addition to the respective requirements previously specified for these two transfer modes, the following common requirements also apply to an M-T-M Transfer Scheme:

(1) When the load is manually transferred between the sources (e.g., to de-energize equipment for maintenance), then any re-transfer of load back to the original source shall only be permitted to be performed in manual (operator supervised and initiated) mode (the transfer scheme shall not permit any automatic re-transfer).

(2) For facilities where multiple Main-Tie-Main Systems co-exist, Customer must ensure that they are properly coordinated.

NOTE: If automatic retransfer logic is part of a standard controller and the logic cannot be modified, then the automatic retransfer logic will need to be disabled and

appropriate placards and procedures need to be put in place as a reminder to personnel.

(C) Excessive fault currents under closed transition conditions may violate the interrupting rating of circuit breakers, or the through fault withstands rating of source transformers, and may damage other connected equipment. Thus, if there is a failure such that the intended main or tie fails to trip, the new source device must automatically be tripped.

14 TESTING AND START-UP REQUIREMENTS

The information outlined in this Section constitutes Start-Up Requirements that apply to any GF. APS may impose additional Start-Up requirements depending on the system impact, type, size, and/or location where the GF is interconnected to the APS System. See sample Site Inspection Plan on ~~www.aps.com/dg.~~www.aps.com/dg. APS will communicate specific testing and/or other additional requirements as soon as practically possible to the Customer prior to final commissioning and/or testing of the GF.

14.1 General Start-Up Requirements

(A) Customer shall, at a minimum, have all specified interface equipment, shutdown and associated protective devices tested and calibrated at the time of installation by qualified personnel and shall also perform functional trip testing of these relays and associated Generator breaker.

(1) Calibration must include on-site bench testing of pickup and timing characteristics of the relays.

(2) Functional testing must demonstrate that each protective relay trip function as required herein, upon a (simulated) out of tolerance input signal, will trip the generator breaker, and shall also include a simulated loss of control power to demonstrate that the generator breaker will open.

(B) Customer must have all equipment installed and certified to any applicable APS, Federal and State requirements and/or codes. **APS may require certifications and/or test reports to be stamped by a Professional Engineer (Electrical) registered in the State of Arizona.**

(C) Customer shall have shutdown testing performed in accordance with IEEE 1547 for abnormal system conditions and provide documentation/proof of such to APS upon request. Additional commissioning tests as required by the equipment standards (i.e., IEEE 1547.1) shall be performed and documentation/proof of such shall be provided to APS upon request.

(D) Customer shall provide a written commissioning test procedure for APS approval to demonstrate required settings and/or modes of operation are in effect.

(E) The Customer is required to have a signed Interconnection Agreement with APS, and must also provide APS with any other required documentation, prior to electrically paralleling the GF with APS's System. The Customer must provide APS with a copy of the Final Electrical Clearance (green tag) for the GF as provided by the AHJ, or provide APS with a duly signed and notarized Letter-in-Lieu of Electrical Clearance if no AHJ electrical inspection is required, before APS will schedule the Site Inspection and meter order.

(F) Customer shall not commence interconnected operation of the GF with the APS System until the GF has been inspected by an authorized APS representative and written

notification is received from APS allowing the GF to commence parallel operation with the APS System.

NOTE: In some cases, a negligible amount of test energy generation may be necessary to test/validate the GF wiring/functionality after receipt of the electrical clearance (green tag) issued by the AHJ, but prior to scheduling APS inspection. Customer assumes all liability in the event the GF causes a hazardous condition for APS, Customer's representatives, general public and any other APS customers. Customer shall request, in writing, permission from APS prior to exporting negligible amount of test energy to validate the GF.

14.2 Static Inverter Systems 1 MW and Larger or any Rotating Machine

(A) The Customer shall provide APS with a certified copy of calibration and functional test results for all GFs comprised of a Rotating Machine and for any GF comprised of Static Inverters with an aggregate AC nameplate rating of 10 MW or larger performed at the time of commissioning of the GF. Customer must also notify APS at least ten (10) business days in advance that such tests are to be performed and allow APS personnel to witness the tests.

(B) For Rotating Machines (Generators), Customer shall repeat such tests performed as specified in Section 14.2(A) at intervals not to exceed four (4) years by qualified test personnel. The Customer shall provide APS with a certified copy of such test results upon request by APS.

(C) The Customer shall give APS at least ten (10) business days prior notice of when initial startup of GF is to begin, and APS will have the right to have a representative present during initial energizing and testing of the GF.

(D) Customer shall provide necessary certification confirming the GF has achieved Qualifying Facility (QF) status as specified in Section 3 of this document.

NOTE: Backup Generators do not qualify as a QF.

(E) Customer shall submit a pre-test calibration and functional test check list, prior to witnessing calibration and functional testing of the GF protective devices (relays) associated with the Generating Facility breaker(s) and full plant trip timing test report for all GF's comprised of Rotating Machines and Static Inverters with an aggregate AC nameplate rating of 10 MW or greater prior to APS witness testing.

(1) Customer shall provide documentation/certification to APS ensuring that the control wiring (along with CT and PT circuitry) has been completed and verified, relay settings have been applied, and any internal trip path testing has been performed (i.e., dry run).

(2) Customer shall provide relay test report(s), equipment test reports (transformers, inverters, generators, etc.) and any other required certification/documentation required by APS prior to granting full permission to parallel with the APS System.

(F) For any GF comprising of Static Inverters with an aggregate AC nameplate rating of 10 MW or larger, Customer shall hire a third-party testing firm to perform full plant trip timing test.

(1) Customer shall provide a test report performed by a qualified testing firm. Test report shall provide trip time, voltage and frequency profile graphs with all inverters on-line (recommend at low power output). Any communication latency between plant equipment at t=0 shall be communicated within the test report.

(2) Customer must notify APS at least ten (10) business days in advance that such tests are to be performed and allow APS personnel to witness the tests. APS, at its option, may elect to connect its test equipment along with, or in lieu of, Customer's test equipment for the purpose of performing the trip timing test.

(3) For the purposes of the trip timing test Customer may be required to disable the Mirrored Bits Receive function at the GF relay(s) for APS Direct Transfer Trip.

15 OPERATIONAL AND MAINTENANCE REQUIREMENTS

15.1 Customer will be responsible for operating and maintaining the GF in accordance with the requirements of all applicable safety and electrical codes, laws and governmental agencies having jurisdiction.

15.2 Customer shall protect, operate and maintain the GF in accordance with prudent engineering and utility practices (Good Utility Practice) and methods. Additionally, Customer shall operate and maintain the GF lawfully in a safe manner and in a non-hazardous condition.

15.3 Customer will allow APS and its authorized agents access to the protective relaying and control facilities to conduct startup or periodic tests APS deems necessary. APS will provide Customer with advance notice of such tests, so that Customer's representatives may be in attendance when tests are performed.

15.4 Customer shall pay annual fees for the Operations and Maintenance (O&M) of APS's new distribution facilities built to accommodate the interconnection of the Customer's GF to the APS System. The Operations and Maintenance Charges (O&MC) covers the costs of the line extension and upgrades and its associate equipment. This O&MC is derived utilizing an APS standard methodology:

(A) Following construction of the dedicated generator tie line, the O&MC is calculated and charged to the Customer based on actual costs of construction.
(B) The actual cost-based O&MC charge will be for the life of the Generator Interconnection Agreement.
(C) The estimated O&MC is the percentage of the actual construction cost (based on the FERC Form-1 data) and is an annual cost to the Customer.
(D) The estimated annual charge will include a 3% escalation for inflation per year over the life of the contract.
(E) Customers required to pay an O&MC will be informed of the fee details during the Interconnection Study process (refer to Section 16.7 of this document).
(F) Behind the Meter/R-DER Customers will not be assessed an O&MC.

15.5 In the event APS or its authorized agents lock open the Disconnect ~~Switch~~, Customer shall not remove or tamper with such lock.

15.6 APS will be allowed to install on Customer's premises any instrumentation equipment for research purposes. Such equipment will be owned, furnished, installed and maintained by APS.

15.7 APS (including its employees, agents and representatives) shall have the right to enter Customer's premises to:

(A) Inspect Customer's GF, protective devices, and to read or test instrumentation equipment that APS may install, provided that reasonable notice is given to Customer prior to entering its premises;
(B) Maintain, replace or repair APS equipment, which may require APS personnel to open the Disconnect ~~Switch~~ without notice;
(C) Immediately and without prior notice disconnect or cause Customer to immediately disconnect, the GF or otherwise render the GF disconnected from the APS System

(including by opening the Disconnect ~~Switch~~) if, in APS's opinion, a hazardous condition exists and such immediate action is necessary to protect persons, APS facilities, or other customers' or third parties' property and facilities from damage or interference, or if, in APS's opinion, any of the protective devices or switching apparatus is not or does not appear to be operating properly;

(D) Open the Disconnect ~~Switch~~ without notice if an operating clearance is required by APS personnel;

(E) Close the Disconnect ~~Switch~~ upon completion of APS work performed under an operating clearance.

15.8 Upon termination of the ~~Interconnect~~Interconnection Agreement, Customer shall be responsible for ensuring that the Disconnect ~~Switch~~ is immediately opened, and that the electric conductors connecting Customer's generator(s) to the Disconnect ~~Switch~~ are lifted and permanently removed, so as to preclude any possibility of interconnected operation in the future. APS reserves the right to inspect Customer's facility to verify that the generator is permanently disconnected.

16 APPLICATION PROCESS AND GENERAL REVIEW REQUIREMENTS

16.1 For a static inverter-based GF with an aggregate AC output nominal ~~AC~~ nameplate ~~output~~ rating of less than 1 kW that interconnects with the APS System, Customer is not required to submit an Interconnection Application. APS will not inspect the installation or prepare an Interconnection Agreement; however, it remains Customer's responsibility to:

(A) Have the system properly permitted and inspected by the AHJ.

(B) Ensure inverters are tested and certified to UL 1741~~/1741 SA~~ per Section ~~8.7~~10.2(A)(~~11~~13).

(C) Conform to all applicable APS interconnection requirements as specified in this document.

16.2 Customers proposing to interconnect a static inverter-based GF are required to submit:

(A) A completed APS Interconnection Application (refer to the ~~APS Interconnection Application Process Guide~~APS Interconnection Application Process Guide available at www.aps.com/dg) along with applicable fees.

~~(B) Diagrams specified per the APS Interconnection Application Process Guide available at www.aps.com/dg.~~

(B) Diagrams specified per the APS Interconnection Application Process Guide available at www.aps.com/dg.

(C) **For Residential Systems**, when ~~specifically required by Utility in writing~~the system design does not follow the standard sample diagrams , Electrical drawings stamped by a Professional Engineer (Electrical) registered in the State of Arizona, may be requested in writing **OR** may be asked to provide a copy of the building permit issued by the AHJ (for applications with no AHJ plan review, refer to Section 16.4 for additional details).

For Commercial Systems, Electrical drawings stamped by a Professional Engineer (Electrical) registered in the State of Arizona.

NOTE: APS may require a copy of the building permit issued by the AHJ when specifically required by Utility in writing (for applications with no AHJ plan review, refer to Section 16.4 for additional details).

16.3 An "Interconnection Application" must be submitted, and all ~~Supplementary~~Supplemental Information requested per Appendix A and the ~~APS Interconnection Application Process Guide available at www.aps.com/dg~~APS Interconnection Application Process Guide shall be provided.

Additionally, diagrams shall be prepared and submitted per requirements specified (refer to Appendix A and the ~~APS Interconnection Application Process Guide available at www.aps.com/dg~~APS Interconnection Application Process Guide and in the format depicted on APS Sample Diagrams located at www.aps.com/dg.

APS will review the Customer provided documentation to determine if the design conforms to APS's requirements. APS reserves the right to require diagrams submitted to be stamped by a Professional Engineer (Electrical) registered in the State of Arizona.

APS notification that the system design appears to be in conformance with APS's Interconnection Requirements does not represent APS' approval of system's design, nor is it an assurance that the system complies with all applicable electric codes, laws, regulations and requirements applicable to its installation and operation.

The building permit, when requested/required, shall be issued by the AHJ following their approval of the diagrams and not the "permit application" form.

It is not necessary to submit a building permit and/or permitted diagrams for 1 MW or greater Static Inverter based systems or Rotating Machines to begin the APS Interconnection Application review.

Note that APS may accept a set of the required diagrams (normally one-line, three-line, array, plant location and site plan) approved by the AHJ provided these diagrams have been prepared in accordance with the ~~APS Sample Diagrams~~APS Sample Diagrams and contain the necessary information shown therein and as otherwise specified in Appendix A of this document and the ~~APS Interconnection Application Process Guide~~APS Interconnection Application Process Guide available at www.aps.com/dg.

16.4 Depending on the GF type and size, APS will review the Interconnection Application and required diagrams for consistency with ~~APS Interconnection Requirements~~APS Interconnection Requirements and provide comments back to Customer or their designee. Diagrams must be in compliance with all NEC, APS, and AHJ requirements. APS will not generally require re-submittal of the Interconnection Application or required diagrams unless the diagrams or system design is revised prior to scheduling APS Site Inspection, or APS requests a resubmittal. As a part of the APS Site Inspection, APS will inspect to ensure all applicable diagram comments made by APS have been incorporated.

If there is no plan review or permit requirement imposed by the AHJ, drawings must be submitted per the APS Interconnection Application Process Guide available at www.aps.com/dg. A notarized copy of APS' ~~Letter-in-Lieu of Electrical Clearance form~~Letter-in-Lieu of Electrical Clearance form is required. ~~Drawings will~~Per 16.2 drawings may need to be stamped by an Electrical PE in Arizona. If the installation is a Supply Side Connection, a Third-Party Inspection will be required, and the completed report will be submitted to APS upon request. See the APS Interconnection Application Process Guide available at www.aps.com/dg for additional details.

NOTE: Diagram reviews by APS do not relieve Customer of the responsibility of full compliance with the APS Interconnection Requirements and all applicable building and safety codes, and local permitting requirements.

16.5 APS's review of documentation submitted by Customer or their designee shall not be construed as a warranty or representation regarding the safety, durability, reliability, performance or fitness of Customer's GF and service facilities (i.e., SES), its control or protective devices, or the design, construction, installation or operation thereof.

16.6 APS strongly encourages Customer to work closely with APS at the conceptual stages of the design to ensure that the project proceeds smoothly. ~~A single point of contact~~A single point of contact with which to coordinate the interconnection process is preferred.

16.7 Following receipt of Customer's Interconnection Application, APS will determine if an Interconnection Study (Study) is required based on ACC Interconnection Rules and/or APS requirements outlined herein. For details of each Study track, please see A.A.C. R14-2-2617

(Level 1 Super Fast Track), A.A.C. R14-2-2618 (Level 2 Fast Track) and A.A.C. R14-2-2618 (Level 3 Study Track). Systems rated at 1 MW or greater ~~nominal~~ generator AC output nominal nameplate rating will require an engineering review/evaluation and/or Study (Schedule 6 may apply) as determined by APS. APS may also perform a Study on any proposed GF with an AC nameplate rating of less than 1 MW in the event an Interconnection Application fails an Interconnection Application Screen as outlined in Section 16.8.

The Study determines whether any modifications, upgrades or additional facilities will be required to the APS System. The Study will also provide estimated costs for equipment additions required including APS System upgrades to interconnect the GF to the APS System. Additionally, the Study will determine any special technical requirements needed. Customer will be responsible for any costs associated with upgrading the APS System in order to accommodate interconnection of the GF. Payment of Interconnection Study fee(s) along with a construction agreement/invoice will be required prior to developing project milestones/schedules. APS reserves the right to cancel any Interconnection Application not interconnected within 180 calendar days after approval with notification to the customer. In addition, If Customer requires additional time beyond 180 calendar days to complete an Interconnection project, the Customer can request a one-time 90-day extension as referenced in ACC Interconnection Rules Section R14-2-2604.

NOTE: When APS requires compliance with Section 11 herein, additional time will be required to procure, install and test/commission the necessary equipment to interconnect the GF with the APS System.

16.8 After APS review of Customer's Interconnection Application, all inverter-based GFs will be subject to Interconnection Application Screens, as outlined in Appendix B, based on engineering analysis for reliability, voltage, and protection of the distribution infrastructure specific to location and proposed system size. In the event an Interconnection Application fails any number of Screens as outlined in Appendix B of this document, Customer will be notified that their Application will require additional review. APS may require that an Interconnection Study be performed to determine additional requirements necessary to approve an Application, as well as to identify solutions that may be implemented to allow interconnection of the GF. If the Generating Facility's operating characteristics can be modified such that improvements to the Distribution System are reduced or not required, and both the Utility and Customer agree on the operating characteristics, the Customer shall have the opportunity to modify the Generating Facility's operating characteristics to reduce facility costs. Additional study ~~fees~~deposits may apply (Refer to Appendix C). Check www.aps.com/dg for the latest information pertaining to interconnecting a DG facility (or facilities) to the APS System. The Customer and/or Customer's representative may request a Pre-Application Report as referenced in ACC Interconnection Rules A.A.C. R14-2-2616 in order to determine if interconnecting at a specific location within the APS System is feasible or not.

16.9 APS will provide Customer with the estimated costs and construction schedule should it be necessary for to upgrade the APS System (i.e., install Dedicated Utility Feeder(s), control or protective devices, remote terminal unit(s), etc.) in order to accommodate or protect Customer's GF or APS equipment. Customer will be responsible for all costs incurred to the extent they exceed those normally incurred by APS for Customers who do not have self-generation facilities, and which must be paid prior to the commencement of any such work.

16.10 Following APS's final Site Inspection of the Customer's Generating Facility, Customer shall not remove, alter, or otherwise modify or change the equipment specifications, including, without limitation, the plans, control and protective devices or settings, and in general the Generating Facility system configuration or any facilities appurtenant thereto that are subject to the APS Interconnection Requirements. If the Customer desires to make such changes or modifications, the Customer must resubmit to APS revised plans describing the changes or modifications for review by APS. No change or modification may be made without the prior written acceptance of APS. Note that APS will not require a resubmittal of a submitted Interconnection Application for any Minor Modifications as defined herein and as referenced in ACC Interconnection Rules Section R14-2-2610.

16.11 Following APS' review of Customer's Interconnection Application and associated diagrams, APS will prepare the Interconnection Agreement, and any applicable other agreements (e.g., Electric Supply/Purchase Agreement, Construction Agreement, Line Extension Agreement, and Operating Agreement) and/or other required documents for execution by APS and Customer.

16.12 Rotating (Backup) Generators, which are not subject to ACC Interconnection Rules, shall submit a completed Interconnection Application along with applicable fees and all Supplementary Information as required by Appendix A and the APS Interconnection Application Process Guide available at www.aps.com/dg, APS will generally require 4-6 weeks for review. APS may require additional time depending on the size and complexity of any such GF. APS will communicate with the Customer's representative should additional time be required for review as soon as practically possible. Customer should discuss project plans with APS before designing its DG or purchasing and installing equipment.

APS Contact

For questions about the APS Interconnection process, general requirements, or other related information ~~to~~contact:

APS ~~Product and Program Implementation~~Renewable Energy Team

Email: renewables@aps.com

Number: 1-800-253-9405 or 602-371-7171

Mail:

APS ~~Product and Program Implementation~~Renewable Energy Team

MS ~~8049~~3200

PO BOX 53933

Phoenix, AZ 85072-3933

For questions about the FERC Interconnection process, general requirements, or other related information, please email interdev@apsc.com.

APPENDIX A: ~~SUPPLEMENTARY~~SUPPLEMENTAL INFORMATION

Diagrams, Specification Sheets and Documents noted below are to be specifically prepared for APS' use, and shall be submitted in pdf format. In addition, a copy of the building permit issued by the AHJ may also be required.

~~**APS will not accept any copyrighted, proprietary or confidential drawings.**~~ **Drawings must be site specific, without extraneous information and must be prepared for APS's use. All electrical connections to equipment must be shown – "block diagrams" will be rejected. Diagrams are to be professionally drawn, using only black print on white paper, and are not to be in color or shaded. Free hand drawn, faxed diagrams and drawings that are otherwise difficult to read on 11" X 17" print will not be accepted by APS.**

All diagrams must include the project name and street address and include any updated diagram revision numbers and dates. If the required information is not provided on the drawings, application and/or supplemental information, then APS will require clarifying information. Clarifying information may include requesting manufacturers cut sheet(s) or the UL certification documents for the device/equipment in question. Refer to Section 16.2, 16.3 & 16.4 of the APS Interconnection Requirements for additional information.

The following table identifies specific document requirements for the application type. Please note there may be additional documentation required to complete an interconnection application. Additional application requirements are specified within the ~~APS Interconnection Application Process Guide.~~APS Interconnection Application Process Guide. In addition, APS has prepared several Sample Diagram sets that indicate the general layout, level of detail, keyed notes, and other information, with the quality required by APS for typical inverter-based systems. These diagrams and APS Interconnection Process Guide are located at: www.aps.com/dg

Required Drawings/Specs/Docs	Static Inverters	Rotating Machinery	Separate Service Generators
Electrical One-Line	X[1]	X	X
Electrical Three-Line	X		
Plant Location	~~X~~[1]X[1]	X	
Site Plan with Elevation Plan	X	X	
Battery Specification Sheets[2]	X		
AC & DC Control Schematics[3]	X	X	
Generator and Transfer Switch Specification Sheets			X
Relay Setting Sheet(s) ~~& Commissioning Plan[3]~~[3]	X	X	
Commissioning Plan[3]	X	X	
Sequence of Operations	X	X	
Manufacturer Switchgear Shop Drawings[3]	X	X	

[1] Diagrams will not be required for Residential Static Inverter Generating Facilities.
[2] Required for all BESS Generating Facilities.
[3] Required for Generating Facilities with AC Aggregate Nameplate Rating of 1 MW or Greater and all Rotating Machines.

APPENDIX B: INTERCONNECTION APPLICATION SCREENS

The following Screens may be applied to any/all proposed inverter based Generating Facility (GF) connecting to a non-network APS distribution circuit. If any Application Screens indicate that the GF may negatively impact the circuit, Customer will be notified along with course of action as noted in Section 16.8 of this document. ACC Interconnection Rules require that an Interconnection Application must pass specific Screens noted below in order to utilize the Fast Track or Super-Fast Track process. Refer to ACC Interconnection Rules R14-2-2617 and R14-2-2618 for additional details. The following ~~descriptions~~description of each Screen is the APS interpretation of the ACC Screen Language.

Screen	Description
A	Is the aggregated generation, including the proposed Generating Facility, on the circuit less than 15% of the total circuit annual peak load or the circuit hosting capacity limit (whichever is greater)? (Y/N)
B	Is the proposed Generating Facility fault current contribution less than 10% of the distribution circuit's maximum fault current value at any point on the distribution system? (Y/N)
C	Is the aggregate Maximum Capacity of existing generation facilities, including the proposed Generating Facility's Maximum Capacity, connected to the proposed distribution circuit less than 90% of any distribution protective devices and equipment short circuit interrupting capability? (Y/N)
D	Is the distribution circuit of the proposed Generating Facility effectively grounded with a system neutral (e.g., 3-phase, 4-wire, 1-phase, 3-wire)? (Y/N)
E	Is the aggregate capacity on 1-phase shared secondary including the proposed Generating Facility <= 75% of transformer kVA rating? (Y/N)
F	Will the proposed Generating Facility, connected to a 1-phase system connected to a transformer providing a 120/240V secondary service, current imbalance be <= 20% of the nameplate rating of the service transformer between the two sides of the 240 Volt service? (Y/N)
G	Is the proposed Generating Facility, in aggregate with other generation interconnected to the distribution side of the substation transformer feeding the distribution circuit, less than 10 MW in an area where there are known or posted transient stability limitations to generating units located in the general electrical vicinity? (Y/N)
H	Is the POI of the proposed Generating Facility connected to a distribution circuit (i.e., not connected to sub-transmission or transmission circuit with a line voltage >= 69 kV)? (Y/N)
I.1[1]	Is the aggregate AC nameplate current rating of the proposed Generating Facility <= the current rating of the Customer's existing electrical service? (Y/N)
I.~~2~~2[1]	Does the customer have a request to upgrade their existing electrical service? (Y/N)
J	Is the Generating Facility inverter based? (Y/N) If no, the Generating Facility must comply with the Protective Function requirements and any additional Utility Interconnection requirements specified by the ~~utility~~Utility in its Interconnection Manual.

[1] NOTE: It is required that the Customer pass either Interconnection Application Screen I.1 or I.2 in addition to applicable/required screens identified above to be approved for the Level 2 Fast Track process as outlined in the ACC Interconnection Rules.

APPENDIX C: ESTIMATED ~~FEES/~~DEPOSIT TABLE

In accordance with ACC Interconnection Rules, the following table of estimated ~~fees/~~deposits shall be applied depending on specific application track and results of applicable Screens (See Appendix B). Any/all ~~fees/~~deposits shall accompany an Interconnection Study Agreement. Refer to Section R14-2-2617, R14-2-2618, R14-2-2619 & R14-2-2620 of the ACC Interconnection Rules for additional details.

Table C.1 *Estimated Deposits*

	Facility Size	Supplemental Study Deposit	Feasibility Study Deposit	System Impact Study Deposit	Facility Study Deposit
R-DER	Under 20 kW	$ -	$ -	$ -	$ -
	20 kW-250 kW	$500.00	$1,000.00	$2,000.00	$3,000.00
	250-499kW	$1,000.00	$1,250.00	$2,500.00	$3,750.00
	500-999kW	$1,500.00	$2,500.00	$5,000.00	$7,500.00
	1-2MW	$2,000.00	Refer to Schedule 6		
U-DER[1]	2-5MW[2]	$3,000.00			
	5-10MW	$5,000.00			
	10+MW	$7,500.00			

[1] Threshold requirements for Dedicated Utility Feeder subject to Section 11.5(G).
[2] Systems within the 2-5 MW range may not require a Dedicated Utility Feeder subject to technical/geographic area specific requirements.

APPENDIX D: RATE SCHEDULES APPLICABLE TO DISTRIBUTED GENERATION

APS Rate Schedules and Rate Riders

There are various rate schedules and rate riders applicable to Customer owned generation that electrically parallels with the APS electric distribution system. Note that participation under a particular rate schedule or rate rider is subject to the GF qualifying for that specified rate schedule or rate rider.

These rate schedules and rate riders are available at www.aps.com.

The rates specified do not apply to backup or standby generation that is used solely for emergency purposes, and that parallels with the Utility for brief periods in order to effect a power transition from the Utility to the backup generation and vice versa.

Rates Disclaimer

1. APS electric rates, basic charges and service fees are subject to change. Future adjustments to these items may positively or negatively impact any potential savings or the value of Customer's GF.
2. Customer will be responsible for paying any future increases to electric rates, basic charges or service fees from APS.
3. Customer's GF is subject to the current rate schedules and rate riders, rules and regulations established by the ACC. The ACC may alter its rules and regulations and/or change rates in the future that could directly impact the economics of Customer's GF.
4. APS and/or the ACC do not sponsor or approve any future electric rate projections presented to Customer. These rates are based on projections formulated by external third parties not affiliated with APS and/or the ACC.

System Size Limiting Factors

1. System sizes are limited by the following factors:
   a. For all qualifying residential and non-residential facilities, system sizes are subject to the requirements found in the Arizona Administrative Code of Distributed Generation Interconnection Requirements (AAC DGIRs). As such, proposed system size must pass the application, screening, and approval process as set forth in the AAC DGIRs.
   b. For all qualifying non-residential DG systems utilizing the EPR-6 rate rider, no system may exceed 125% of connected load for its meter, where connected load is defined as the maximum demand divided by 0.6.
2. Additional system sizing information to note:
   a. In alignment with Industry standards, APS utilizes a DC/AC conversion factor of 85% (AC = 0.85 X DC).
   b. Service entrance equipment is the jurisdiction of both the Utility and the Authorities Having Jurisdiction (Non-APS entities). This equipment also limits system sizes and

may be required by the AHJ to be sized to accommodate the customers proposed system.